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ANOMALIES OF THE COCHLEA IN PATIENTS WITH NORMAL HEARING*

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Many anomalies in the development of the cochlea have been described from the anatomical point of view, but rarely has there been a correlation between the structural change and the hearing acuity of the patient. The seventeen temporal bones described in this paper were all from patients on whom an otoscopic examination and functional tests with tuning forks and audiometer were made a short time before death. They illustrate a variety of congenital abnormalities in the cochlea, none of which were associated with an impairment of hearing. No histologic changes in the vestibular apparatus were found.

There was a dehiscence in the bony septum between the middle and apical turns in six of the seventeen cochleæ (Fig. 1). This anomaly was described by Alexander, who called it scala communis cochleæ. According to some theories of hearing, a scala communis, which establishes a free communication between the scala vestibuli and the scala tympani, should impair the hearing. The location of the defect in our cases should theoretically impair the hearing for low tones,

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but the audiometer test showed normal threshold acuity for all tones in every patient. One patient had a scala communis cochleæ on both sides, while in four others this defect was unilateral. In each of these four patients the hearing was equally good on the two sides.

Arrested development of the bony structures in the apex of the modiolus was present in two patients (Fig. 2). Here again the lesion was unilateral and the hearing was equally acute on the two sides. Fibrous bands support the nerves which supply the apical turn.

In one patient there is a defect on the right side in the bony wall of the middle turn of the cochlea and some fibers of the facial nerve actually pass through a part of the spiral ligament (Fig. 3). The relation of the facial nerve to the cochlea was normal on the opposite side. Our records show that he occasionally had pain in the right ear and tinnitus "like bells." The acuity of hearing, however, was the same on the two sides.

Normally the cochlea of man has two and a half or two and three-quarter turns. One cochlea in this group, however, has only two turns (Fig. 4), and another has three full turns (Fig. 5). The hearing was normal for all tones in both patients. The basilar membrane was measured, by Dr. Mary Hardy, in the serial sections of these two cochleæ and was found to be within the upper limits of normal. It seems justifiable to assume that the number of turns in the cochlea is of little importance for hearing acuity for all tones, provided the length of the basilar membrane is within normal limits.

Slight variation in the position of an individual turn of the cochlea in relation to the modiolus is often seen. This type of variation is illustrated in Fig. 6, which shows the lower basal turn is more distant from the modiolar axis than normal and is turned at an unusual angle.

In the left ear of a man, 30 years of age, the scala vestibuli is much smaller than the scala tympani (Fig. 7). The difference in size is due to the osseous spiral lamina, which leaves the modiolus at a higher level than normal. The abnormality is limited to the lower basal turn. On the right side the cochlea is normal. The hearing was normal and identical in the two ears. The cochlea in Fig. 6 also shows a difference in the size of the scala vestibuli and the scala tympani for a limited area in the basal turn.

There is a dehiscence in the bony wall of the osseous spiral lamina in two patients. This lesion is limited to the basal turns of the cochlea: is bilateral in one case and unilateral in the other. This condition is

illustrated in Figs. 8, 9 and 10, from the cochlea of a colored boy 18 years of age. Figs. 8 and 9 show a defect in the bone in both the lower and upper basal turns. In these areas the nerve lies in a fibrous canal. Other abnormalities in the cochlea of this patient are shown in Fig. 10. This section, nearer the mid-modiolar axis, shows a gap in the osseous spiral lamina and a cyst like formation which deflects the course of the nerve. The hearing was normal in both patients.

Vascular anomalies were found in the cochleæ of two patients. In the right ear of a colored man, 56 years of age, the vas spirali lies in the basilar membrane (Figs. 11 and 12). The normal location of this vessel is in the connective tissue on the under surface of the basilar membrane. The patient occasionally had tinnitus in both ears: the artery, however, was in this abnormal position in one ear only. The hearing was normal on both sides for all tones. In an apical turn of the cochlea of a white man, 59 years of age, a blood vessel with a few supporting strands of connective tissue crosses the scala tympani and one branch attaches itself to and theoretically should interfere with the vibration of the basilar membrane (Fig. 13). This patient had no tinnitus and the hearing was normal for all low tones of the audiometer.

CONCLUSION

Some congenital abnormalities of the cochlea are described and illustrated. The patients were all examined shortly before death and none of them had any impairment of hearing or other symptoms that could be ascribed to the structural changes in the cochlea.

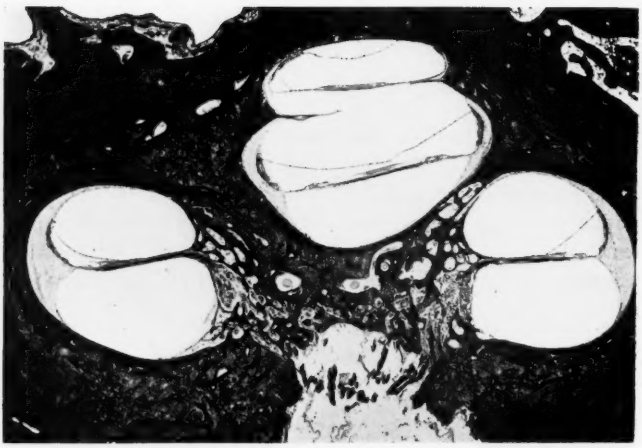

Fig. 1. Photomicrograph of cochlea showing dehiscence in the bony septum between the middle and apical turns.

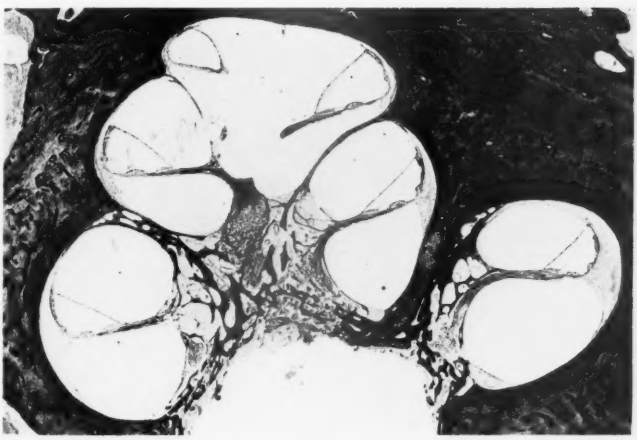

Fig. 2. Photomicrograph of cochlea showing an absence of the modiolus about the middle turn. Fibrous bands connected the upper middle turn of the cochlea with the apical turn.

Fig. 3. Photomicrograph showing a part of the middle turn of the cochlea and facial canal. A few of the fibers of the facial nerve here invade and run through the spiral ligament.

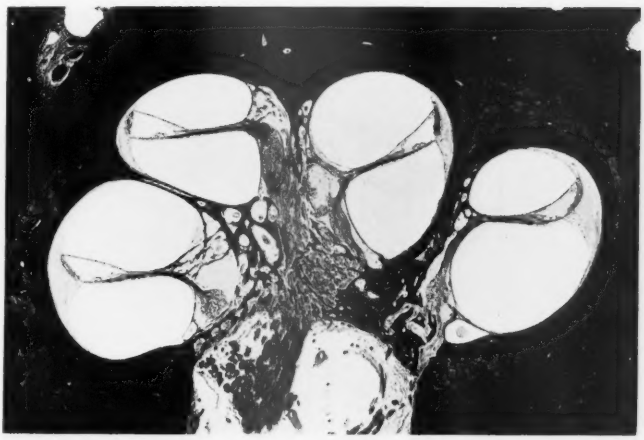

Fig. 4. Photomicrograph of mid-modiolar section of the cochlea in which the organ of Corti is present at only four levels. Compare with Fig. 5.

Fig. 5. Photomicrograph of mid-modiolar sections of the cochlea in which the organ of Corti is present at six levels. This cochlea had three full turns and the cochlea in Fig. 4 had only two.

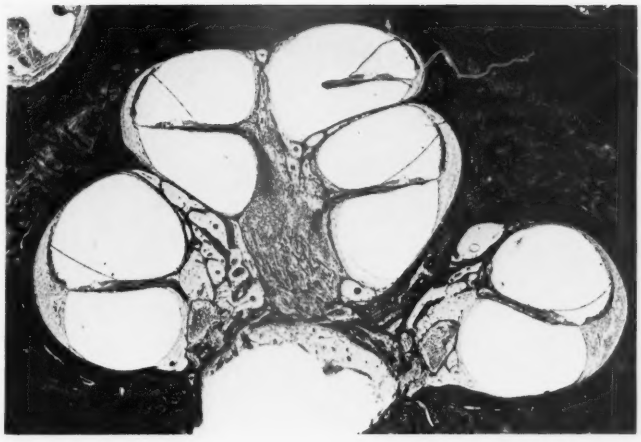

Fig. 6. Photomicrograph of mid-modiolar section of the cochlea showing a common and one of the slightest deformities in the cochlea. The bony framework between the modiolus and the lower basal turn of the cochlea is wider than normal. This part of the cochlea is turned so that the bony spiral lamina is at an unusual angle in its relationship to the modiolus.

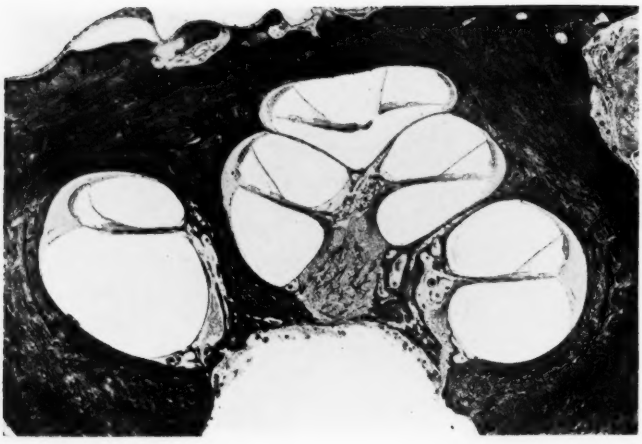

Fig. 7. Photomicrograph of section near the mid-modiolar region of a cochlea with the osseous spiral lamina of the lower basal turn placed unusually high. This causes a marked disproportion in the size of the lumen of the scala vestibule and scala tympani.

Fig. 8. Photomicrograph of lower basal turn of cochlea showing absence of bone in parts of the bony spiral lamina.

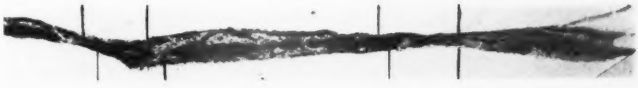

Fig. 9. Photomicrograph with higher magnification of the same part of the bony spiral lamina as in Fig. 8. The absence of bone is in the area between the perpendicular lines.

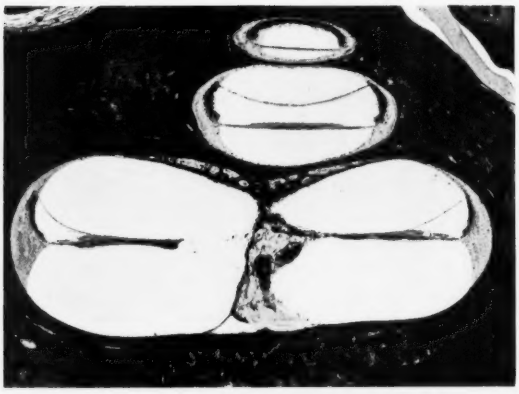

Fig. 10. Photomicrograph of the same cochlea as in Fig. 8, only a little posterior. Here there is a dehiscence in both the bone and fibrous part of the spiral lamina.

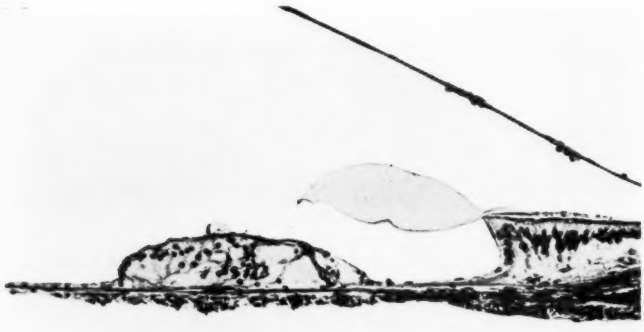

Fig. 11. Photomicrograph of the organ of Corti of the lower part of the apical turn of the cochlea. This shows the vascular spirali located in the basilar membrane. The supporting cells of the organ of Corti are just about the vessel.

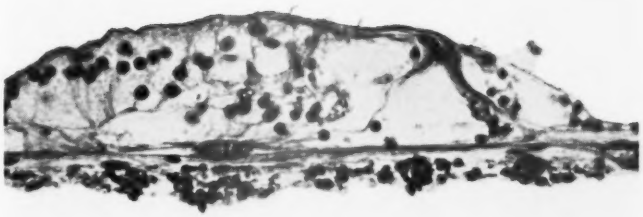

Fig. 12. High magnification of the photomicrograph shown in Fig. 11.

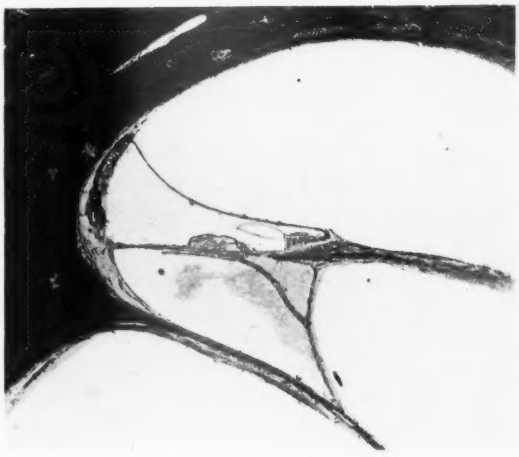

Fig. 13. Photomicrograph of section of the lower apical regions of the cochlea which shows a blood vessel crossing the scala tympani.

LI

OBSERVATIONS ON SINUS ABNORMALITIES IN CONGENITAL TOTAL AND HEMI-ABSENCE OF THE NOSE*

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The presentation of these meager observations on such a very small series of cases might be excused on the theory that they at least add to the total number of cases available for study.

There is an occasional reference made in the literature to the condition shown in Fig. 1. There is a woodcut in W. H. A. Jacobson's "Operations of Surgery," and we have recently seen a photograph of this condition in an adult, but we have never encountered any very plausible explanation of its "why" or "how." Certain individual deviations that were found in all our cases suggest that a similar condition had at some earlier period been present in all congenital half-noses.

The main points of similarity in the four other cases to be cited were the total absence of one lateral half of the external nose and also of that anterior naris, a marked downward inclination of the inner canthus on the affected side, a downward displacement of the eye-slit, and perhaps some deformity of the globe, a flattening of that cheek, and a small but distinct skin mark or bony nodule above the inner canthus. In one case (Fig. 2), it was reported that a fleshy tumor had been detached from this site three days after birth.

Three of the cases are known to have had a complete blockage of the normal tear drainage below the lachrymal sac. In two of the cases no observation was made on this point. In one case the nasal passage was patent as far forward as a skin-covered diaphragm at

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the anterior naris (Fig. 3). In two of the five cases (Fig. 1 and Fig. 4), there was known to have been a complete occlusion at or near the posterior naris, and in one case (Fig. 6) there was a lower turbinate bone against which the vomer was tightly approximated, with no observable open passageway. In another case (Fig. 2) there was no recorded observation of the nasopharynx. In all but one case (Fig. 1) the pronounced flattening of the cheek suggested a poor development or complete absence of that maxillary sinus.

In the cases illustrated by Figures 1 and 4, a mucus-filled cavity was opened and explored on account of retained secretions. Case 1 was too young for identification of the antrum, but the distended mucous lining, apparently complete, was removed from a large, rather globular cavity. The fact that the facial incision healed without persistence of the fistula was taken to indicate that the removal of the mucosa was complete. In Case 4 we were able to make a complete visual display of the sinus cavity, but no nasal passage on that side was found. In both these cases there was apparent absence or obstruction of the nasal duct, and this gives rise to an interesting speculation as to the source from which the mucous lining of these cavities was derived. In one case of total absence of the external nose and nasal passage forward of the nasopharynx, no evidence of a paranasal sinus cavity was found either by x-ray or while chiselling an air passage from the face to the nasopharynx. The thought has come that the tubular mass removed from Case 1 and presumably from Case 2 might have included what should have been the missing nasal duct. The attachment of the tube above the internal canthus might seem to render this an impossible hypothesis, but some explanation might come from citing the occurrence of a double tear sac occurring in a case of partially open facial cleft. Lacking adequate embryological data, one might imagine a nasal duct attached above directly to the upper canaliculus or to a rudimentary sac, the lower canaliculus being entirely absent. In none of the four operated cases was any evidence found of an internal palpebral ligament.

Unless it is assumed either that the nose is developed entirely from the globular processes or that the fronto-nasal process is originally formed from two separate lateral processes, it is difficult to make an embryological explanation either of this or of the completely bifid nose that remains continuous with the cheek on each side.

METROPOLITAN BLDG.

Fig. 1. Shows an infant born with the right half of the nose missing from its natural position, but having a cylindrical tube of tissue lined with mucosa and covered with skin attached by a narrow stalk above the inner canthus. Apparently tears drain through this tube.

Fig. 2

Fig. 3. In this instance the globe of the opposite side was either shrunken or missing.

Fig. 4. A 21-year-old girl with the left half of the nose congenitally missing and a deformed globe on that side which was displaced outward and downward. Near the internal canthus was a fistula from which mucous extruded, and above was the characteristic mark which might have been the site of attachment of a mass similar to that shown in Fig. 1. On opening into the mucous cavity through an incision mesial to the internal canthus, a large, partially loculated mucous-lined cavity was found that extended quite a distance backward, was separated from the orbit by a thin bony partition, but which did not extend below the level of the orbital floor. These findings correspond to the x-ray picture. Permanent drainage of this cavity was obtained by making a large window into the right nasal passage through the thin bony wall that separated these two cavities. The change in the appearance shown in the second picture was obtained by several subsequent operative steps.

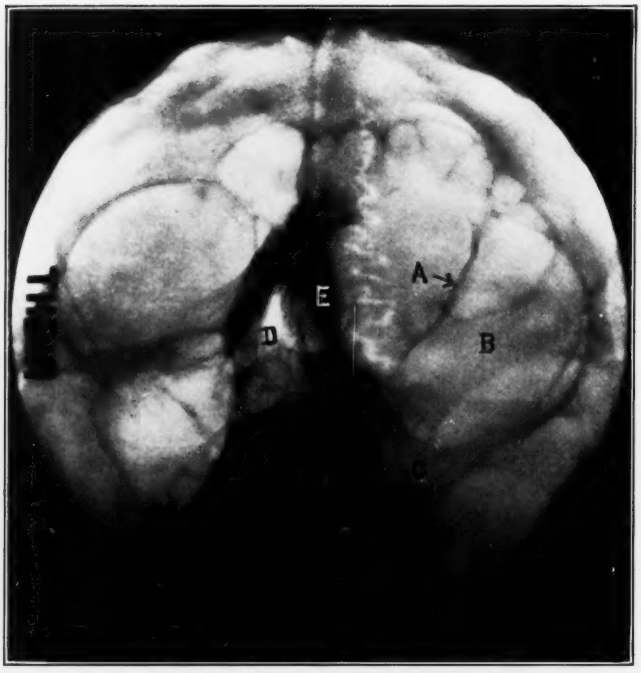

Fig. 5. X-ray of case shown in Fig. 4. Our interpretation, based not only on this x-ray, but on the condition found at operation, is that the cavity marked *A* represents the sinuses, and the fistula referred to in the legend under Fig. 4 opened into this cavity. The arrow points to what was probably the *os planum* of the ethmoid which formed the barrier between the sinus cavity and the orbit *B*, and the thickened mass of bone marked *C* would normally have contained the maxillary antrum. *D* is the right nasal chamber and *E* is the partition between the sinus cavity *A* and the right nasal cavity *D*. The bony partition between *A* and *B* was removed allowing the globe to travel toward the midline as shown in the second photograph of Fig. 4, and a window was made through the wall *E* for permanent drainage of *A* into *D*.

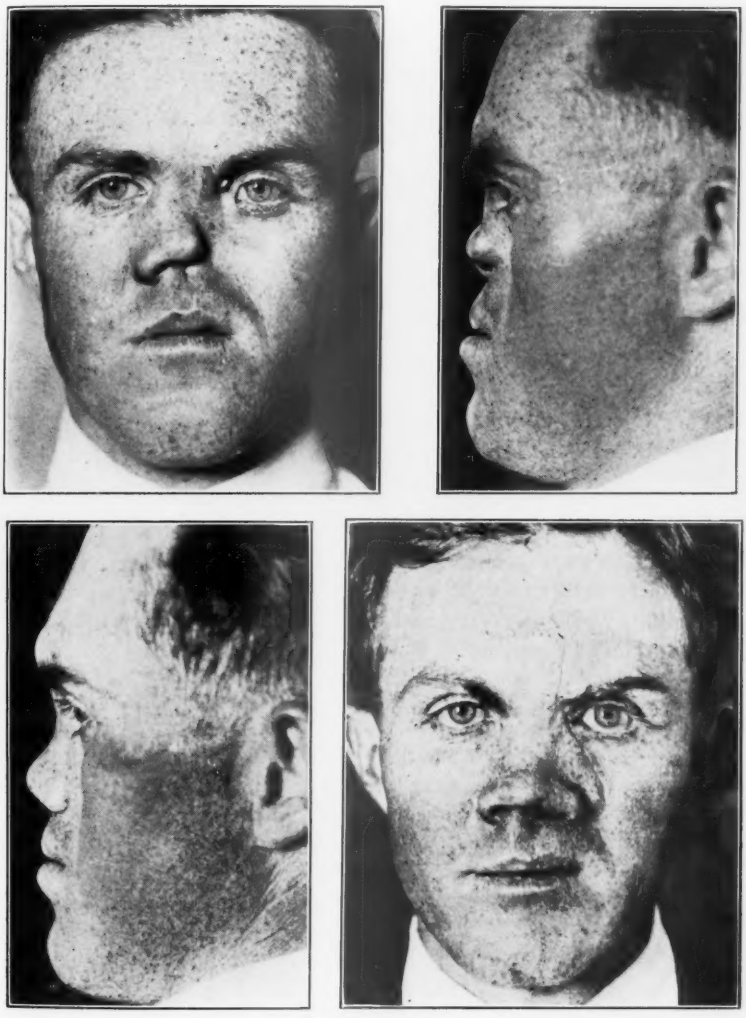

Fig. 6. Shows a case of congenital half nose and the surgical correction of the external deformity in a 24-year-old man. In the first picture the point of presumable attachment of a one time fleshy mass and also the flattening of the zygomatic eminence were very evident.

LII

NASAL BLOOD VESSELS WHICH SERVE AS ARTERIES IN SOME MAMMALS AND AS VEINS IN SOME OTHERS*

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This is mainly a study of two functions of the nasal blood vessels. One of these functions is the conduction of arterial blood and the other is the conduction of venous blood. The problem of the functions of these vessels is inseparably coupled with the problem of the architectural arrangement of them in the lining of the nasal passages. The general architectural arrangement of the networks of nasal blood vessels is amazingly similar in all of the mammals that I have studied, but the functions of individual vessels and of complete networks of nasal vessels in some mammals are the reverse of those functions in some other mammals. This coupled problem involves certain problems of vasculogenesis. The entire problem is one that is so difficult to comprehend that I shall present some of the principal observations in the form of photographs and photomicrographs and shall discuss these results by making frequent reference to the schematic illustrations presented as Figs. 1, 2, 3 and 4 after these first four figures have been fully explained.

Figs. 1, 2, 3 and 4 are schematic representations of observations which were made prenatal and postnatal on various mammals. It should be imagined that each of these figures is a reasonably accurate reproduction of a cross-section of a small portion of the nasal lining. It should also be imagined that the lumina of the vessels are filled with India ink and that the surrounding tissue, including the walls of the vessels, has been cleared so that only the ink in the lumina can be seen. Fig. 1 represents a stage of development during early intrauterine life in mammals with long gestation periods or during relatively late intrauterine life in mammals with relatively very short gestation periods. At this stage the horizontal networks of vessels and the simple anastomotic connections between these networks have already developed. (In a later paper I shall discuss the development of these blood vessels and also the origin and development of the

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lymph vessels in the nasal lining.) Later stages of development of the vessels are represented by Figs. 2, 3 and 4. In a general way Fig. 4 represents the permanent arrangement of the blood vessels in the greater part of the nasal lining of any adult mammal that might be selected for examination. The functions of the vessels will be stated after the architectural arrangement of them has been explained.

The principal networks of nasal blood vessels (excluding the general capillary network) form three strata at different depths in the lining (Fig. 1, SS, MS and DS). In the greater number of mammals the superficial stratum (Fig. 1, SS) can be analyzed into two networks or reticulæ which might be spoken of as the greater superficial network (Fig. 1, C) and the lesser superficial network (Fig. 1, B). These networks are associated with one another by means of simple anastomoses (Fig. 2, K), which remain relatively simple in some mammals but become somewhat distended and tortuous in some others. In order to avoid making Figs. 1, 2, 3 and 4 unnecessarily complex all of the horizontal anastomoses of each network (such as B or C of Fig. 1) were omitted, certain variations in the size of the horizontal vessels at different ages were ignored and the metamorphosis[2, 4] of the arteriovenous anastomoses or AVAs was represented as being much simpler and more systematic than it often is.

In the greater number of mammals the middle stratum (Fig. 1, MS), like the superficial stratum (Fig. 1, SS), can be analyzed into two networks or reticulæ which might be called the greater middle network (Fig. 1, E) and the lesser middle network (Fig. 1, F). The networks of the middle stratum, like those of the superficial one, are closely associated with one another by means of simple anastomoses (Fig. 2, M) which remain relatively simple in some mammals but become quite tortuous in some others.

The deep stratum (Fig. 1, DS) consists of only one network of vessels of various sizes. In some mammals, such as the rabbit and dog, the vessels of this stratum collapse and become functionless "ghost" vessels or merely potential spaces (Figs. 2, 3, 4, 29 and 30) during late fetal life and early postnasal life. In other mammals, such as the sheep and deer, they remain patent throughout life at either all or only some parts of the lining.

The lesser networks of the superficial and middle strata are connected with one another in early intrauterine life by means of simple arteriovenous anastomoses or AVAs (Fig. 1, D) which undergo complete metamorphosis as was described in an earlier paper.[2] The metamorphosis of these embryonic AVAs is shown in Figs. 5, 6 and 7.

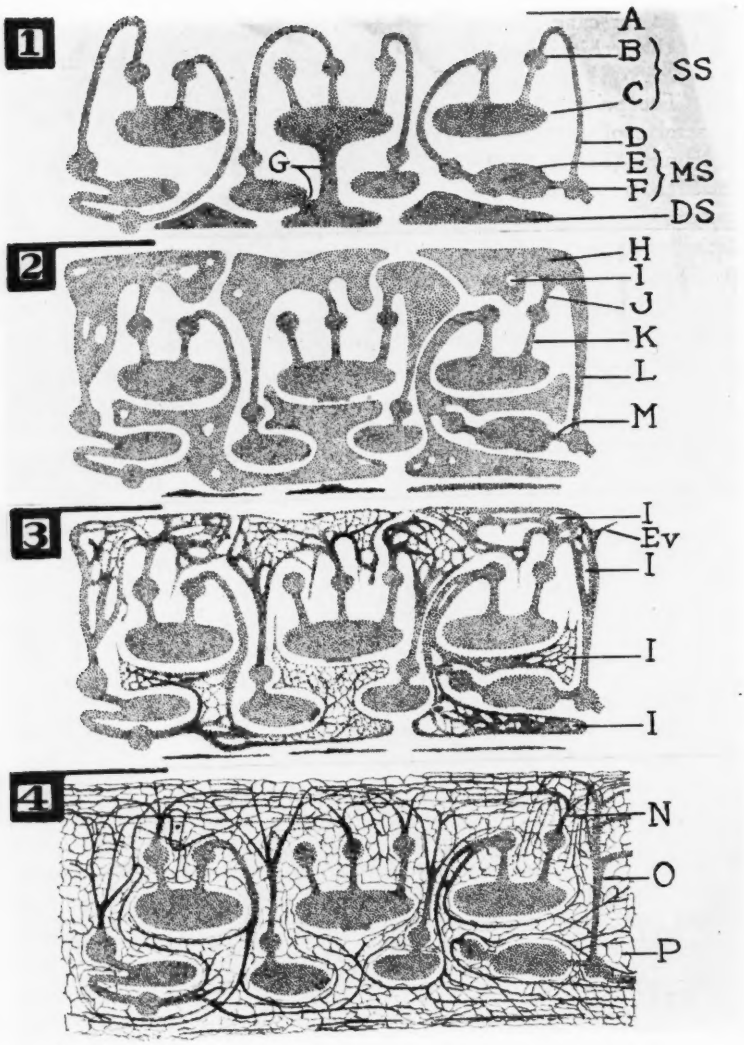
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Fig. 1. This is a schematic representation of a cross-section of a small part of the nasal lining of either a typical V/A or a typical A/V mammal before the arteriovenous anastomoses (AVAs) have metamorphosed into capillaries and certain other small vessels.

A, the location of the epithelium.

B, a network of small veins in the V/A lining or a network of small arteries in the A/V lining.

C, a network of large veins in the V/A lining or a network of large vein-like arteries in the A/V lining.

SS, the superficial stratum of vessels in both the V/A and A/V types of lining. SS consists of two intricately associated networks of veins (*B* and *C*) in the V/A lining or of two intricately associated networks of arteries (*B* and *C*) in the A/V lining. *B* is the lesser network or reticulum and *C* is the greater network or reticulum of this stratum.

D, AVAs in both the V/A and A/V types of lining.

E, a network of large arteries in the V/A lining or a network of large veins in the A/V lining.

F, a network of small arteries in the V/A lining or a network of small veins in the A/V lining.

MS, the middle stratum of vessels in both the V/A and A/V types of lining. MS consists of two intricately associated networks of arteries (*E* and *F*) in the V/A lining or of two intricately associated networks of veins (*E* and *F*) in the A/V lining. *E* is the greater network or reticulum and *F* is the lesser network or reticulum of this stratum.

DS, the deep stratum of vessels in both the V/A and A/V types of lining. The vessels of this stratum are veins in fetal and early postnatal V/A mammals, but they are only potential spaces or "ghost" veins in the adult V/A mammals. In some A/V mammals this stratum persists as arteries. Only some parts of it persist as arteries in other A/V mammals.

G, anastomoses which connect parts of the deep stratum with parts of the superficial and middle strata. Stumps of these anastomoses are shown in Fig. 25. The anastomoses connecting the deep stratum with the vein-like arteries in the A/V lining persist as helicine arterial anastomoses. The anastomoses connecting the deep stratum with the middle stratum of the A/V lining undergo metamorphosis to form capillaries and certain other small vessels. In Figs. 2, 3 and 4 the changes in the deep stratum are represented as they occur in such a V/A mammal as the dog.

Fig. 2. This figure depicts a stage of development in which the AVAs have dilated and thereby formed diminutive blood swamps in which a small number of swamp islands (small areas of tissue surrounded by blood) and accordingly a small number of swamp channels have developed. The metamorphosis of the AVAs is often not as systematic or simple as is schematically illustrated in Figs. 2, 3 and 4. It is very frequently the case that an AVA dilates only slightly before it divides into two or more parts, and it is also frequently the case that these parts form hairpin loops which grow in different directions and attain different lengths and sizes before each of them divides into two or more parts, and so on until the metamorphosis is complete. Such a hairpin loop frequently divides at its tip, but it may also divide at other points along its course. It is also common for such a hairpin loop to fuse with a similar loop of another metamorphosing AVA and later divide at various points along its course.

H, a blood swamp. The AVA has dilated, and evaginated portions of the walls have moved in different directions into the surrounding tissue.

I, a swamp island. Invaginations, as well as evaginations, take place as the cells in the swamp walls proliferate. Whenever opposite walls are brought firmly in contact with one another, because of external tissue pressure or because of an invagination of a wall, these walls fuse and then parts of the fused portions of them vanish. The birth of such a swamp island means the birth of an additional blood vessel or swamp channel.

J, the venous leg of a metamorphosing AVA in the V/A lining or the arterial leg of the metamorphosing AVA in the A/V lining.

K, a venous anastomosis in the V/A lining or an arterial anastomosis in the A/V lining.

L, the arterial leg of a metamorphosing AVA in the V/A lining or the venous leg of the metamorphosing AVA in the A/V lining.

M, an arterial anastomosis in the V/A lining or a venous anastomosis in the A/V lining.

Fig. 3. At this stage of development so many swamp islands (*I*) have formed that the diminutive blood swamps have become converted into many swamp channels of many sizes. Some of the swamp channels are small arteries, some others are small veins, some others are secondary AVAs and the others are capillaries. At this stage of the metamorphosis the various vessels loop individually and collectively in various directions into the tissue. The secondary AVAs, like the primary ones, undergo metamorphosis. The capillaries (and often some larger vessels) fuse with capillaries of other metamorphosing AVAs and thereby form a continuous capillary network throughout the lining, as represented in Fig. 4. Small evaginations (*Ev*) of various sizes and shapes also develop and fuse with other vessels and with one another to form new vessels. These evaginations are injectable.

Fig. 4. All of the AVAs have undergone complete metamorphosis. The capillaries seem to be very numerous, but the number of them per unit of area becomes smaller as the lining grows in different directions. Some of the capillaries vanish during the growth of the tissue. It is also true that some new capillaries develop from some veins of the lesser reticulum of the superficial stratum in certain V/A mammals and from some arteries of the lesser reticulum of the superficial stratum of certain A/V mammals. The capillaries that survive best are those in the vicinity of the epithelium and the periosteum. Many of the tissue islands that are surrounded by capillaries and larger blood vessels also change considerably in shape as the lining grows.

N, a venocapillary anastomosis in the V/A lining or an arteriocapillary anastomosis in the A/V lining. These arteriocapillary anastomoses are very frequently so simple that they can be referred to as postreticular endarteries. In some instances the terminal artery is divided in such a manner into two or more parts that an arterial network is the result. Such a division occurs so infrequently, however, that it is almost always correct to refer to the postreticular arteriocapillary anastomoses as postreticular endarteries.

O, a postreticular endartery in the V/A lining or a venocapillary anastomosis in the A/V lining.

P, capillaries or the smallest swamp channels in both the V/A and A/V types of lining.

In some instances the metamorphosis does not take place until after birth. A result of the metamorphosis is that the three principal strata of blood vessels are imbedded in a complex network of capillaries and some other small vessels (Fig. 4) which, like the capillaries, originate from the AVAs. It might seem preposterous that no capillaries are shown in Figs. 1 and 2, but there are also no capillaries in Figs. 21, 22, 23, 24 and 25 which were obtained from an eighteen day fetal rabbit. I have at times fostered the common desire to speak of such vessels as some or even all of those in Figs. 21, 24 or 25 as capillaries, but I am now convinced that this is a desire that should not be fostered. Some capillaries can be seen in Figs. 6, 7 and 20. The true capillaries do not develop in the nasal lining until the AVAs, and in some cases young arteries and young veins undergo division to form diminutive networks of small vessels as shown in Figs. 6 and 7 and as illustrated schematically in Fig. 3. Some of the vessels of these networks are capillaries. The true capillaries originate from pre-existing vessels of various sizes. Some capillaries, as well as some other small vessels, arise as diverticulæ of vessels of various sizes. These diverticulæ grow in length until they meet and fuse with other diverticulæ and other vessels. These diverticulæ often become very slender and pointed as they grow through the tissue (Fig. 3, Ev.). They are commonly known as endothelial buds or capillary sprouts, but they should not be confused with some buds or sprouts which develop in the early embryo as solid columns of cells.

The entire superficial stratum (Fig. 1, SS) in the canidæ (all kinds of dogs) conducts venous blood and should accordingly be looked upon as consisting of veins, while the greater part of this stratum in the bovidæ (all kinds of cattle, antelope, sheep and goats) conducts arterial blood and should accordingly be looked upon as consisting of arteries. The middle stratum (Fig. 1, MS) in all parts of the nasal lining of the canidæ consists of arteries. In the greater part of the nasal lining of the bovidæ the middle stratum consists of veins. It will be convenient to designate the relative depths of these arterial and venous strata in the canidæ by using the abbreviated expression V/A. This means only that the upper or superficial stratum consists of veins and that the middle stratum consists of arteries. I shall accordingly speak of the V/A lining, the V/A circulation and the V/A mammal. Any member of the bovidæ should be spoken of as an A/V mammal because it has the A/V type of circulation in the greater part of the nasal lining.

From the rhinangiologic point of view herein entertained the V/A type of mammal consists of the human being, monkey, dog, cat, bear, rabbit, rat, porcupine, mink, opossum, armadillo and many

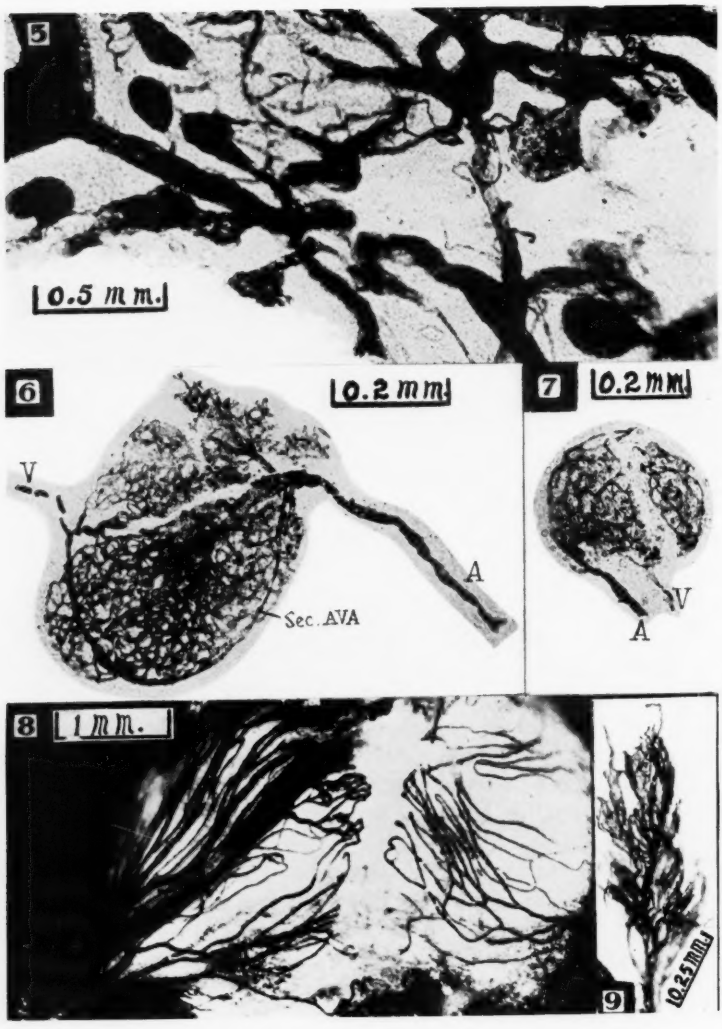
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Fig. 5. A part of the lining of the nasal septum of a grizzly bear cub three or four days after birth. Some of the lining was dissected away in order to show clearly some diminutive blood swamps similar to those schematically represented in Fig. 2. Some tissue islands had developed in some of these swamps. It is exceedingly difficult to inject such swamps without rupturing the thin walls to cause petechial ink or cinnabar hemorrhages in which no histologic structure can be identified. It is somewhat unusual for the diminutive swamps to be as symmetrical as they are in Fig. 5. India ink injection. Ordinary photography. Transmitted light.

Fig. 6. A metamorphosing AVA in the nasal lining of a late fetal lemur. This is an unusually fortunate injection. First India ink and then vermilion cinnabar was injected into an umbilical artery. A small amount of cinnabar is in the arterial leg (*A*) of the AVA. The column of ink in the venous leg was broken into segments as a result of inadvertent stretching of the vein. At least one secondary AVA (Sec. AVA) can be seen. Some of the smallest vessels are permanent capillaries. The specimen was photographed by using ordinary photography and transmitted light.

Fig. 7. An incompletely metamorphosed AVA from the nasal lining of a 25-day fetal rabbit. The conspicuous break in the network of swamp vessels is an artifact which was accidentally created while removing the AVA from the lining. India ink was injected into an umbilical artery. Ordinary photography with transmitted light.

Fig. 8. A vascularized mass of vermilion cinnabar (the white area) in the vitreous chamber of an eye of an adult guinea pig. The cinnabar caused panophthalmitis. Vessels in the necrotic uvea looped or elbowed their way into the cinnabar and then divided to form networks of smaller vessels. The bipolar retæ are relatively simple, but they are otherwise very similar to those in Figs. 6 and 7. I have seen the entire cornea (of rabbits, guinea pigs, owls and some other animals) become vascularized by this method. The only difference was that the marginal vessels of the cornea, instead of the uveal vessels, looped into the substance of the cornea after it became soft and necrotic. Many of the capillaries were stretched and broken as the larger vessels looped away from their normal positions. The retracted capillary stumps have erroneously been called endothelial sprouts by Arnold[1] and others. These stumps often grow into the necrotic tissue and fuse with other stumps and also unbroken capillaries. The relatively simple form of vasculogenesis shown in Fig. 6 is common in the nasal lining and many other parts of the body during embryonic and fetal life. The specimen was photographed by using the Eastman 1R infra-red plate with reflected light. India ink was injected into a common carotid artery.

Fig. 9. An incompletely metamorphosed AVA in the substance of the brain of an adult opossum. Such instances of permanently arrested metamorphosis of AVAs are numerous in the central nervous system of this animal and also in the central nervous system of the wallaroo kangaroo.[4] Note hairpin loops formed by the smallest vessels. The metamorphosis of such an AVA cannot be said to be complete until at least some of these loops grow farther into the tissue and fuse with similar vessels from other metamorphosing AVAs to form a general network of capillaries. India ink was injected into a common carotid artery. Ordinary photography. Transmitted light.

others. The A/V type consists of the ox, antelope, sheep, goat, deer and probably the giraffe. The greater number of the wallaroo kangaroos are V/A mammals. Two wallaroo kangaroos (out of a total of thirty or more examined) were found to be of the A/V type. A relatively small number of mammals, such as the pig and the camel, are rhinangiologically different from the typical V/A and A/V mammals in one or more respects. Only some of the unmistakable V/A and A/V mammals are considered in this paper. I consider it advisable to devote a separate paper to the human being and the monkeys.

Figs. 5, 6, 7, 8 and 9 show some of the facts which I held in mind while drawing Figs. 1, 2, 3 and 4. The glomerulus-like structures in Fig. 5 are some diminutive blood swamps which are essentially like those in Figs. 2 and 3. These swamps are the dilated portions of some AVAs. Holes have already developed in some of the swamps, although this is not as evident in the photomicrograph as it is in the specimen itself or as it is in Fig. 6. These holes are the tissue islands or swamp islands in the diminutive swamps. The blood channels which surround these swamp islands are the swamp channels which may be called capillaries, arterioles, venules and secondary AVAs. It is somewhat unusual to get these blood swamps as nicely injected with India ink as they are in Figs. 5, 6 and 7. The walls almost always rupture so that definite histologic structures can often not be recognized in the resulting ink hemorrhages. For instance, the skin of an eighteen-day fetal rabbit can be perfectly injected from an umbilical artery without causing a single ink hemorrhage, but I have not found it possible to obtain a perfect injection of the skin of a twenty-one-day fetal rabbit without causing numerous petechial ink hemorrhages. In many instances the ink hemorrhages were found to be due to the rupturing of AVAs which were in various stages of metamorphosis at the time of the injection.

The AVAs do not undergo metamorphosis at the same time in all parts of the body. In some mammals this metamorphosis of the AVAs in the nasal lining and certain other parts of the body takes place in late fetal life and early postnatal life. In some instances the metamorphosis is greatly delayed. In some other instances it is permanently arrested, as shown in Fig. 9. The metamorphosis of an AVA is not complete until at least some of the capillaries fuse with capillaries of other metamorphosing AVAs.

Fig. 7 has a remarkable resemblance to a glomerulus. It is architecturally the same as a glomerulus. In fact, a glomerulus is only an incompletely metamorphosed portion of an AVA. The metamorphosis is arrested by the epithelial tissue of the Bowman capsule

which is a physical obstruction to the growth of the capillaries in different directions through the kidney tissue so that they can meet and fuse with capillaries of other metamorphosing AVAs. Parts of some (not all) of the renal AVAs beyond the glomeruli undergo complete metamorphosis to form a general capillary network and some other small vessels. A kidney in which the shape alone, the structure alone or both the shape and the structure of the free end of each of the uriniferous tubules is such that a blood vessel cannot loop into or elbow its way into this end remains an aglomerular kidney. (It is my intention to devote a separate paper to the discussion of the complete and incomplete metamorphosis of the renal AVAs.) The metamorphosis of the AVAs in the nasal lining is fundamentally the same as in the kidney and other parts of the body, although the bipolar retæ of the metamorphosing AVAs in many parts of the body are often much simpler and more irregular in appearance than the glomeruli and the especially selected retæ shown in Figs. 5, 6 and 7.

Fig. 8 shows a stage in the vascularization of a mass of vermilion cinnabar which was injected into the vitreous humor of the eye of an adult guinea pig. The tissue of the uvea became too necrotic and soft to hold the uveal vessels in their normal locations. Here and there a vein or an artery looped or elbowed its way out of the uveal tissue and into the mass of cinnabar. Each of these vessels dilated at various places and then divided into two or more vessels. Bipolar retæ accordingly developed throughout the mass of cinnabar. Only some of the vessels, at the surface of the mass, are shown in Fig. 8.

At many parts of the body, even in the nasal lining, AVAs loop or elbow their way into the soft tissue and then form bipolar retæ which are very similar to the bipolar retæ that originate from the arteries or the veins in the mass of cinnabar. The vascularization of the substance of the brain, in almost all mammals, is very similar to the vascularization of the mass of cinnabar. However, the vessels which undergo metamorphosis in the brain are AVAs which loop away from the pial networks of arteries and veins and into the brain substance.[1] Fig. 9 shows a case of arrested metamorphosis of an AVA in the substance of the brain of an adult opossum. The type of vasculogenesis seen in Fig. 8 takes place in the nasal lining and various other parts of the body of a mammal in its prenatal life and also in the earlier part of the postnatal life of some mammals. During this vasculogenesis many blood vessels vanish. The vascularization of the mass of cinnabar is essentially the same as the vascularization of a necrotic cornea, a necrotic area in the nasal lining or a necrotic area in any other part of the body of either a young or an adult mammal.

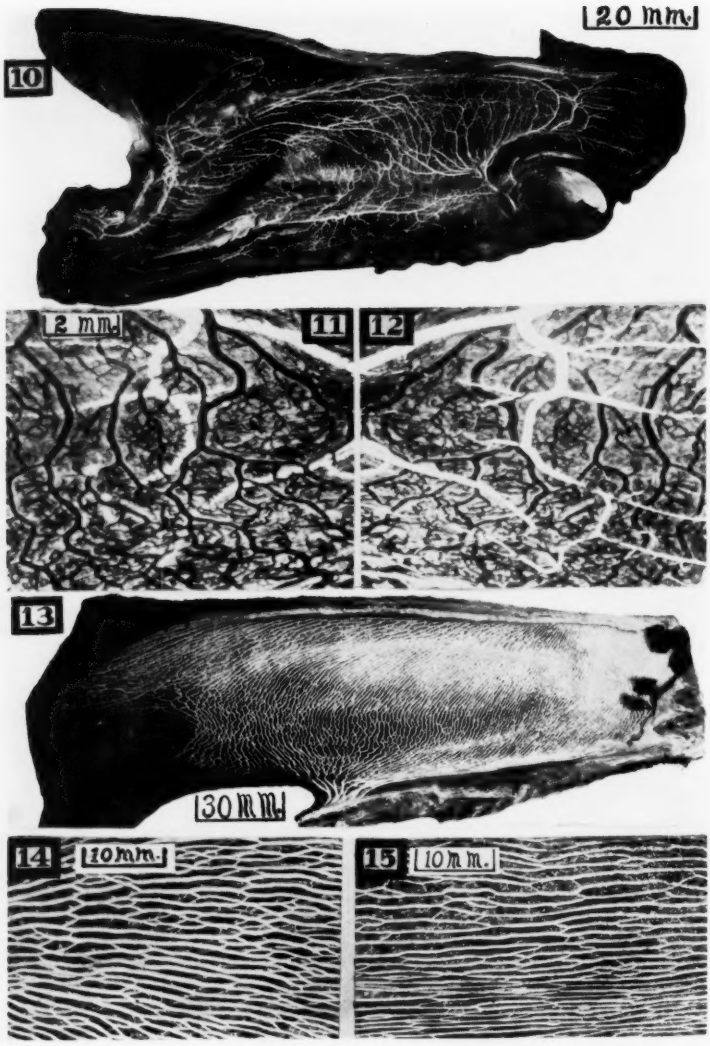
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Fig. 10. The middle stratum (Fig. 1, MS) of blood vessels (Arteries) in the lining of the nasal septum of a V/A mammal, a grizzly bear cub. The arteries were injected with vermilion cinnabar. Infra-red photography. Reflected light.

Fig. 11. A portion of the lining of the nasal septum of an adult black bear. The arteries were injected with vermilion cinnabar and the veins with India ink. The superficial stratum (Fig. 1, SS) consists of veins. The middle stratum (Fig. 1, MS) consists of arteries. The deep stratum (Fig. 1, DS) did not become injected. Note that the veins cut the arteries. The network of the relatively large and conspicuous veins is the greater reticulum (Fig. 1, C) of the superficial stratum (Fig. 1, SS). The relatively small veins constitute the lesser reticulum (Fig. 1, B) of the superficial stratum (Fig. 1, SS). This reticulum really consists of many little networks which are connected with one another by means of capillaries, as can be appreciated by observing the specimen. These capillaries were originally venous anastomoses which passed immediately above the larger anastomoses of the greater reticulum. Note that the anastomoses of the lesser reticulum still pass over the arteries. The arteries are too deeply situated to create sufficient pressure on these venous anastomoses to cause them to divide up to form capillaries. Infra-red photography. Reflected and transmitted light.

Fig. 12. This is the same as Fig. 11 except that Fig. 12 was photographed from the periosteal side of the lining. Note that the arteries cut the veins.

Fig. 13. The greater reticulum (Fig. 1, C) of vein-like arteries of the superficial stratum (Fig. 1, SS) in the lining of the nasal septum of an A/V mammal (Rocky Mountain bighorn sheep). The lesser or secondary network (Fig. 1, B) of arteries of the superficial stratum (Fig. 1, SS) of arteries became injected at many points in the lining, but these vessels are so slender that they cannot be seen clearly in this figure. At some of the lightest areas in the figure some of the capillaries and also some of the veins (Fig. 1, MS) became injected. Infra-red photography. Reflected light. The vessels were injected with vermilion cinnabar.

Fig. 14. The superficial stratum (Fig. 1, SS) of a part of the lining of a ventral turbinate from the same sheep as for Fig. 13. Capillaries and veins did not become injected. The arteries of the lesser reticulum (Fig. 1, B) have very small lumina. The lumina of the vein-like arteries of the greater reticulum (Fig. 1, C) are relatively very large. The technic was the same as for Fig. 13.

Fig. 15. A portion of the A/V lining of the nasal septum of a reindeer. The middle stratum (Fig. 1, MS) consists of veins which are deeper than the vein-like arteries of the superficial stratum (Fig. 1, SS). The veins became injected. They can be seen in the spaces between the anastomoses of the network of vein-like arteries. The technic was the same as for Figs. 13 and 14 except that the vessels were injected first with a weak solution of hydrochloric acid to increase the lumina of the capillaries so that a considerable amount of the cinnabar could be urged through these capillaries and into the veins.[2]

Fig. 10 shows only the middle stratum of nasal vessels in a V/A type of mammal (grizzly bear). This stratum can be analyzed into two delicately interlaced arterial reticulæ (the greater and the lesser networks) which are connected with one another by means of arterial anastomoses as represented by M in Fig. 2. The mesh of the greater reticulum is considerably coarser than that of the lesser one. The reticulum of the coarser mesh (the greater reticulum) was referred to in an earlier paper as the primary network of arteries.[3] Arterial blood flows first into the greater or primary reticulum, then into the lesser or secondary one and then into the capillary network via the side branches of the individual anastomoses of the lesser or secondary reticulum. These side branches are the arterio-capillary anastomoses or postreticular endarteries (Fig. 4, O). Aside from the fact that the secondary network is of finer mesh than the primary one, the individual arteries of the secondary network are relatively slender, the walls of these slender arteries are very muscular and thick in proportion to the size of the vessels, the greater number of these arteries have postreticular endarteries as side branches, and a considerable portion of the secondary network is somewhat more superficial than the primary one.

Fig. 11 shows the veins, as well as the arteries, in the lining of the nasal septum of an adult black bear. The veins are black and the arteries are white. Two venous networks (Fig. 1, B and C) can be seen. These constitute the superficial stratum (Fig. 1, SS). Fig. 12 is a photomicrograph of the same specimen, but it was taken from the periosteal side. This figure shows clearly that the veins are more superficial than the arteries and also that the deep stratum (Fig. 1, DS) did not become injected. The lesser reticulum of the superficial stratum (Fig. 1, SS) is peculiar in the adult bear and some other adult mammals for the reason that some of the veins of this reticulum have become divided (during late fetal and early postnatal life) into capillaries at the points at which these veins arched over the larger veins of the greater reticulum of the same stratum. (The capillaries cannot be seen clearly in the photomicrographs although they can be clearly seen in the specimen when they are properly magnified). This division of the veins into capillaries does not take place in certain V/A mammals, as the dog (Fig. 30), in which the lesser and greater reticulæ of the superficial stratum are separated by a greater distance than is the case in the bear and certain other mammals. Even some of the arteries of the lesser reticulum in the A/V lining of certain A/V mammals become divided into capillaries at some of the points where these arteries are originally applied closely to the large vein-like arteries of the superficial stratum. This type of

vasculogenesis is comparable to that shown in Fig. 8. In both instances parts of some veins and arteries metamorphose into smaller vessels.

Because of the pressure of the underlying veins, opposite walls of the smaller veins are forced together at some points in such an animal as the bear. These walls fuse at the points of contact of them. Tissue islands are accordingly born, and the birth of each of these islands means the birth of a new blood vessel. These tissue islands become more and more numerous, due to the pressure of the underlying veins, until the resulting vessels are too small for more islands to develop in them. This type of vasculogenesis then ceases. Many of the new vessels which fail to undergo further division are capillaries. One consequence of this vasculogenesis is that the lesser reticulum of the superficial stratum is converted essentially into a mosaic of simple reticulæ (Figs. 11 and 12). This vasculogenesis is more complete at some parts of the lining than at others.

The conspicuous arteries shown in Fig. 13 constitute the greater reticulum (Fig. 1, C) of the superficial stratum (Fig. 1, SS) of vessels in the A/V type of nasal lining of an A/V type of mammal (sheep). These were earlier referred to as vein-like arteries because they have essentially the histologic structure of veins of the same size at some other parts of the body.[2] The greater part of the secondary network or lesser reticulum (Fig. 1, B) did not become injected. This network can be seen, however, in Fig. 14, which is also from the A/V lining of a sheep. The walls of these relatively superficial arteries of the stratum are very thick in proportion to their size, but after they are injected and the tissue (including the arterial walls) is cleared they seem to be very slender because only the injected material (vermilion cinnabar) in the very narrow lumina is visible. The analysis of the nasal arteries in Fig. 14 into two reticulæ which lie at slightly different depths in the tissue can be made with less burden on the imagination than is experienced when a comparable analysis of the arteries in the V/A type of lining (Fig. 10) is undertaken. The distance between the greater and lesser reticulæ of the superficial stratum is exaggerated for the sake of clearness in Figs. 1, 2, 3 and 4.

Fig. 15 is from a portion of the A/V lining of a deer (reindeer). It shows quite clearly that the veins (Fig. 1, MS) are deeper than the vein-like arteries (Fig. 1, C). Parts of the deep stratum (Fig. 1, DS) normally persist at many parts of the lining of the sheep. The deep stratum in the A/V lining of the sheep and other A/V animals consists of arteries. The anastomotic connections (Fig. 1, G) between

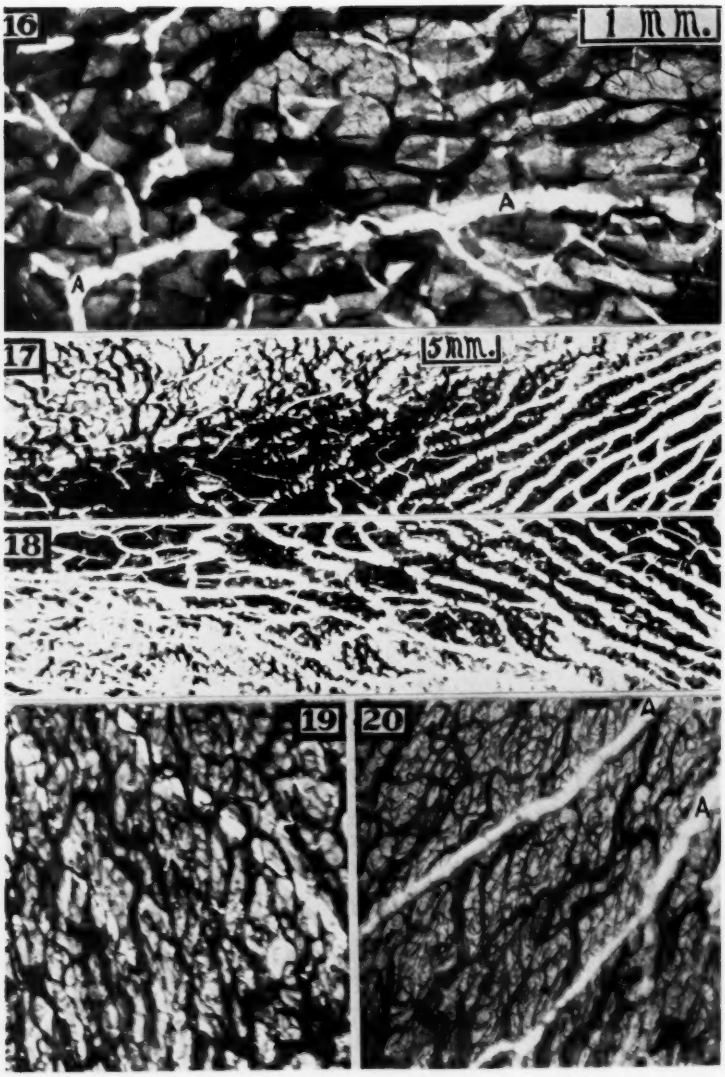
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Fig. 16. A portion of the lining from an ethmoturbinate of an A/V mammal (wapiti or American elk). The veins (black) were injected with India ink and the arteries were injected with vermilion cinnabar. The veins and arteries are interlaced, but the greater number of the veins are more superficial than the arteries. Note that the arteries do not resemble the vein-like arteries shown in Figs. 13, 14 and 15. However, the veins of the greater reticulum in Fig. 16 have a remarkable resemblance to the vein-like arteries of the superficial stratum at many parts of the A/V lining of the wapiti and certain other A/V mammals. There is not an anatomic reversal of the superficial and middle strata in the lining of the ethmoturbinates, but there is a reversal of function of these strata. Infra-red photography. Reflected and transmitted light.

Fig. 17. The region of the reversal of function of the superficial and middle strata at the posterior end of the nasal septum of a Rocky Mountain bighorn sheep. Note that the arteries (white) cut the veins (black) at the extreme right end, that the reverse is true at the extreme left end and that the arteries and veins are intricately interlaced midway between the ends of the figure. The lining to the right in the figure is of the A/V type and that to the left in the figure is of the V/A type. Parts of the lesser reticulum (Fig. 1, B) of the superficial stratum (Fig. 1, SS) can be seen in Fig. 17. The arteries were injected with vermilion cinnabar and the veins with India ink. Infra-red photography. Reflected and transmitted light.

Fig. 18. The same as Fig. 17 except that the specimen was photographed from the periosteal instead of the epithelial side. The motheaten appearance of the vein-like arteries to the right is due to cutting by veins. Some of these veins did not photograph clearly because the ink was pressed out of them at the points where they pressed against the arteries. The arterial and venous strata are very close together everywhere in this part of the lining. Parts of the deep stratum can be seen in the figure. The arteries of this stratum are very slender.

Fig. 19. A portion of the lining from a relatively posterior region of the nasal septum of a V/A mammal (adult rabbit). The technic was the same as for Fig. 16. The magnification is also the same as for Fig. 16. Fig. 4 is a reasonably accurate representation of the relationships of the vessels in Fig. 19. Note that the deep stratum of potential spaces did not become injected.

Fig. 20. This is the same as Fig. 19 except that the specimen was photographed from the periosteal instead of the epithelial side. The small gray vessels which cut the white arteries are some of the capillaries and other small vessels which originated from the AVAs. These small vessels between the middle stratum and the periosteum are schematically represented in Fig. 4. Figs. 19 and 20 should be compared with Figs. 22, 24 and 25 which are from about the same posterior region of the septum of a fetal rabbit instead of an adult one.

this stratum and the vein-like arteries (Fig. 1, C) are helicine arteries of various sizes. The original anastomotic connections (AVAs) between the deep stratum of arteries and the middle stratum of veins in the A/V lining metamorphose into capillaries and certain other small vessels. The deep stratum of arteries and the helicine anastomotic connections between this stratum and the vein-like arteries of the superficial stratum are not shown clearly in any of the figures in this paper, but the deep stratum in the A/V lining resembles the lesser reticulum of the superficial stratum of arteries (Fig. 14). Some parts of the deep stratum of arteries can be seen in Fig. 18. For some reason that is not clear to me it is often very difficult or even impossible to obtain a perfect injection of the deep stratum of arteries in the A/V lining of some adult A/V mammals when vermilion cinnabar is used as the injection medium. It is not difficult to inject all parts of the deep stratum with India ink.

Fig. 16 is from the lining of an ethmoturbinate of an A/V mammal (deer). This is mainly the V/A type of circulation. This figure shows merely a part of a considerably larger region of transition from the A/V circulation present in the greater part of the lining to the V/A circulation which exists at the margins of the lining (including that of the greater part of the ethmoturbinates) and also outside the nasal passages. In the V/A mammals such a transition cannot be found because the V/A circulation exists outside the nasal passages as well as in the nasal lining. Fig. 17 shows the greater part of the region of transition at the extreme posterior end of the nasal septum of an A/V mammal (sheep). A similar transition is found in the vicinity of the posterior and also the anterior nares. Fig. 18 shows the transition as seen from the periosteal instead of the epithelial side of the same specimen from which Fig. 17 was obtained.

Fig. 19 is from a V/A mammal (rabbit). With the exception of the deep stratum (Fig. 1, DS) all of the vessels are well injected. The superficial vessels (black) which cut the arteries (white) consist of the primary and secondary networks of the superficial stratum (Fig. 1, SS) and also of some capillaries and other small vessels which originated from the embryonic AVAs. These capillaries and other small vessels are shown schematically in Fig. 4. Some of the capillaries and other small vessels pass underneath the middle stratum (the white arteries) as shown in Fig. 20 and as illustrated schematically in Fig. 4. Fig. 20 is the same as Fig. 19 except that Fig. 20 was obtained by photographing the specimen while the periosteum was turned toward the camera. The rabbit is one of a small number of V/A mammals in which the primary or greater network of veins of the superficial stratum does not have a striking resemblance to

the primary network of vein-like arteries of the superficial stratum in the A/V lining of an A/V mammal.

Figs. 21 to 25 inclusive are from the nasal septum of a V/A mammal (an 18-day fetal rabbit). In these figures there are young arteries, young veins and young AVAs as illustrated in Fig. 1. The permanent capillaries, such as can be seen in Figs. 19 and 20, do not develop in the nasal lining of the rabbit until late fetal life and early postnatal life. In mammals with a considerably longer prenatal life a much greater number of these capillaries develop before birth. This distinction between the true or permanent capillaries and the smallest vessels of the embryo may seem to be an unimportant one, but I am convinced that some very interesting phases of vasculogenesis have heretofore been overlooked as a result of the notion that the early vessels, such as many of those in Fig. 21, are permanent capillaries. The permanent capillaries, and also some other permanent vessels, develop as a result of invaginations and also evaginations of the walls of pre-existing vessels. The permanent capillaries are permanent in the sense that they remain capillaries as long as the tissue about them remains relatively normal and also solid enough to prevent either destruction of them or only permanent, exaggerated dilatations of them.

Fig. 22 is from the rectangular area in Fig. 21. The blood vessels in Fig. 22 consist of the superficial stratum of veins (Fig. 24), the middle stratum of arteries, the deep stratum of veins (Fig. 25), venous anastomoses (Fig. 25, G) connecting parts of the superficial stratum (Fig. 24) with parts of the deep stratum (Fig. 25), and AVAs connecting parts of the middle stratum with parts of the superficial and deep strata. In my efforts to remove the superficial stratum from the others the greater part of the middle stratum was destroyed. A considerable portion of the deep stratum (outside the rectangular area in Fig. 23) was also inadvertently destroyed. The veins of the deep stratum (Fig. 25) cannot be seen in the lining of the adult rabbit (Fig. 20). Some time after birth these vessels become functionless "ghost" vessels or mere potential spaces without definite walls, as they also do in the dog (Figs 29 and 30) and other V/A mammals.

A comparison of Fig. 24 with Fig. 19 or 20 reveals that the superficial stratum of veins shown in Fig. 24 was destined to undergo some interesting changes if the animal had lived. Some of these vessels, especially the more superficial ones of the stratum, normally divide to form the characteristic smaller ones of the lesser reticulum and then many of these vessels of the greater and lesser reticulæ of

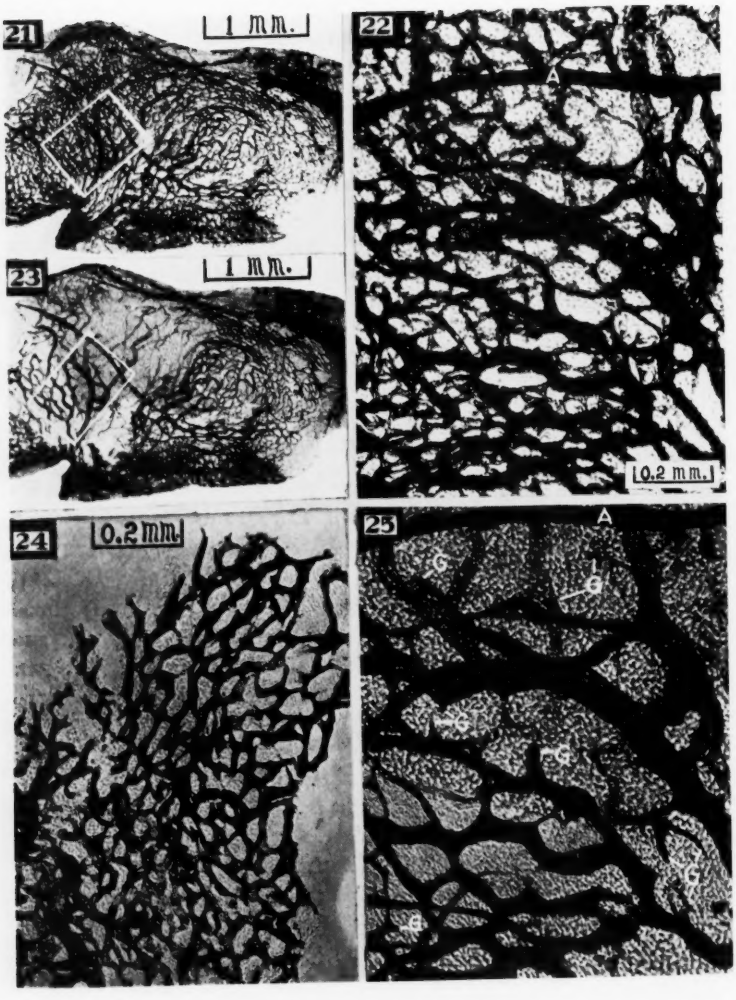
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Fig. 21. The nasal lining on the right side of the nasal septum of an 18-day fetal rabbit. All of the vessels on the left side of the septum were dissected away. India ink was injected into an umbilical artery while the heart was still beating. Figs. 22, 24 and 25 are from the rectangular area in Fig. 21. India ink injection. Ordinary photography. Transmitted light.

Fig. 22. The vessels shown in this figure are from the rectangular area in Fig. 21, and they are schematically illustrated in Fig. 1. The embryonic AVAs are still present. The capillaries have accordingly not developed. One artery of the middle stratum is much larger and more conspicuous than the other arteries of this stratum. Some of the veins of the deep stratum are considerably larger than any in the superficial stratum. In this connection the deep stratum shown in Fig. 25 should be compared with the superficial stratum shown in Fig. 24. Ordinary photography. Transmitted light.

Fig. 23. This is the same as Fig. 21 except that the magnification is slightly greater, that the superficial stratum was intentionally dissected away and that the greater part of the middle stratum and some of the deep stratum were unintentionally destroyed in making the dissection. Fig. 25 is from the rectangular area in Fig. 23. Ordinary photography. Transmitted light.

Fig. 24. A small part of the superficial stratum which was dissected away from the rectangular area in Fig. 21. Ordinary photography. Transmitted light.

Fig. 25. This is an enlarged portion of the deep stratum in the rectangular area in Fig. 23. Cartilage cells can be seen through some of the mildly injected veins of this stratum. These veins are not imbedded in the cartilage. They are very close to the periosteum. Ordinary photography. Transmitted light.

A, an artery of the middle stratum.

G, stumps of venous anastomoses which connected the deep stratum of veins with the superficial stratum of veins and also stumps of arteriovenous anastomoses which connected the deep stratum of veins with the middle stratum of arteries. These venous and arteriovenous anastomoses were broken when the superficial stratum and the greater part of the middle stratum were removed by microdissection. These stumps are parts of the anastomoses schematically illustrated as *G* in Fig. 1. The vessels of the deep stratum were destined to become potential spaces or "ghost" vessels (similar to those in Fig. 29) if the animal had lived. The deep stratum cannot be seen in Figs 19 and 20.

the stratum increase in size as the animal grows. The division of one of these vessels to form two or more smaller ones is fundamentally the same as the simple process illustrated in Figs. 2, 3, 6, 7, 8 and 9. Tissue islands or swamp islands develop in the veins, and these islands become so numerous at some parts of the lining that the veins become capillaries as many of them do in the bear (Figs. 11 and 12). The features of the stratum change still more as the septum increases in length and breadth.

Fig. 26 shows a part of the nasal lining from the left side of the septum of a V/A mammal (dog). The superficial stratum (veins) is well injected The most conspicuous veins of this stratum are very similar in appearance to the most conspicuous arteries (vein-like arteries) of the superficial stratum of the A/V lining shown in Fig. 13. The middle stratum in the dog consists of arteries, but no part of this stratum became injected in this specimen (Fig. 26). The deep stratum in the adult dog, as in other adult V/A mammals, consists of functionless "ghost" veins. These are shown in Figs. 29 and 30. The "ghost" veins are distinguishable in a part of Fig. 26.

The specimen shown as Fig. 26 was photographed after a layer of it (Fig. 27) was torn away. The upper part of the specimen was considerably thicker than the lower part of it before the layer of tissue (Fig. 27) was removed, but the superficial stratum of veins was found to be at about the same distance from the periosteum at all points in the lining. It may be observed (Fig. 26) that the layer of tissue (Fig. 27) was removed without disturbing a considerable part of the superficial stratum of veins. The layer of tissue shown as Fig. 27 was more superficially located than the superficial stratum (Fig 1, SS) of veins. This tissue contains various vessels which originated from the AVAs (as illustrated in Fig. 4). Many of these vessels became exceptionally large and tortuous and thereby caused this part of the lining to become exceptionally vascular above the superficial stratum (Fig 1, SS). Such an exceptional development of these vessels in certain parts of the nasal lining is a normal occurrence in many mammals, but it does not upset the rhinangiologic classification of mammals into the V/A and A/V types or of nasal linings into the V/A and A/V types. An artery and some of the simplest veins that can be seen in Fig. 27 (in the rectangular area) are shown in Fig. 28. Only a very small number of the capillaries became injected.

Fig. 29 shows the deep stratum (Fig. 1, DS) after the vessels have collapsed (as illustrated in Figs. 3 and 4) and have become functionless "ghost" vessels. The relatively small vessels with definite

walls are some of the small veins which originated from AVAs, as is schematically illustrated in Figs 2, 3 and 4. These small vessels are not connected with the "ghost" vessels. I have never found blood in the "ghost" vessels of an adult V/A mammal, and I have never been able to inject them in an adult V/A mammal except by deranging a small part of the tissue very close to the periosteum with a hypodermic needle and then forcing ink or cinnabar into the deranged tissue. I have often found it impossible to inject these potential spaces (the "ghost" vessels) in very fresh specimens. The potential spaces inject much better after a certain amount of putrefaction has taken place. These spaces can be opened up in a fresh specimen by placing it in hydrogen peroxide, but ink or cinnabar then passes so readily through the walls that the features of the network can rarely be recognized after the injection is made.

The superficial stratum (Fig. 1, SS) is well injected in Fig. 30. The greater reticulum (Fig. 1, C) of this stratum is morphologically and also histologically the same or at least very similar to the greater reticulum (the vein-like arteries) of the superficial stratum in many parts of the A/V lining of the wapiti and some other members of the deer family. The network of capillaries is not injected at any place in the figure, but parts of many venocapillary anastomoses can be seen. These anastomoses are the venous trunks of the metamorphosed AVAs (Fig. 4, N). These trunks are side-branches of the venous anastomoses of the lesser network (Fig. 1, B) of the superficial stratum (Fig. 1, SS). Only one artery contains some ink. This vessel passes almost across the right end of the figure. This artery is not a part of the middle stratum. It is more superficial than the superficial stratum. It is a vessel which originated from an AVA. The potential spaces of the deep stratum are smaller and are not as perfectly injected as they are in some parts of Fig. 29.

There is no transition of function in the nasal lining of the V/A mammal. It is my tendency, therefore, to look upon the V/A circulation as being the fundamental or basic type. This tendency is strengthened by the fact that the greater number of mammals are of the V/A type. The tendency is further strengthened by the observation that even the A/V mammal has the V/A type of circulation in the mucous lining and skin outside the nasal passages. The A/V mammal is accordingly a rhinangiologic freak.

In an effort to explain the reversal from the basic type of circulation in the mucous membrane and skin outside the nasal passages to the freak type that exists in the greater part of the nasal lining of an A/V mammal attention must be given principally to the AVAs.

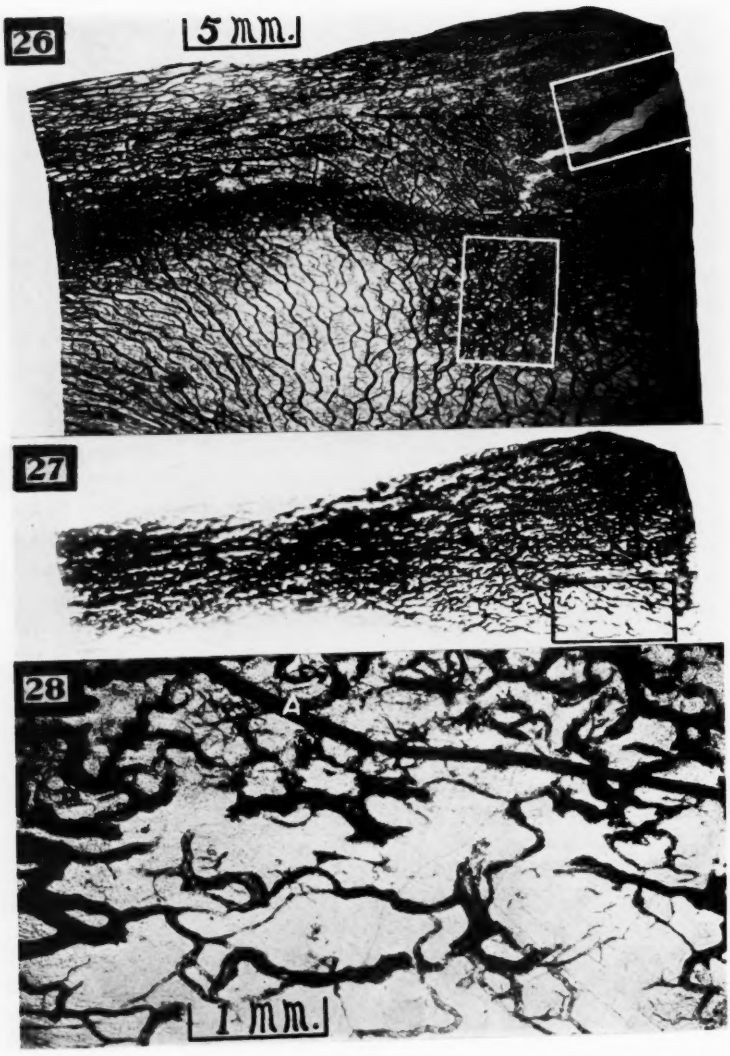
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Fig. 26. A portion of the lining from the left side of the nasal septum of an adult dog. The dog is a V/A mammal in which the nasal lining is exceptionally thick at certain regions. This increased thickness of the lining is due to an increase in the thickness of the tissue exteriorly to the superficial stratum of blood vessels. Many blood vessels which originate from the AVAs become large and tortuous in the superficial thickened tissue. This superficial tissue may be pulled away from the deeper portion of the lining without seriously disturbing the superficial stratum (Fig. 1, SS) of vessels. Fig. 27 is such a layer of tissue which was taken from the upper part of the specimen presented as Fig. 26. The most conspicuous veins in Fig. 26 constitute the greater reticulum (Fig. 1, C) of the superficial stratum of vessels (Fig. 1, SS). The similarity of these veins to the vein-like arteries of some A/V mammals is remarkable. The lesser reticulum (Fig. 1, B) of the superficial stratum (Fig. 1, SS) is well injected, as inspection of Fig. 30 reveals. Fig. 30 is from the lower rectangular area in Fig. 26. The capillaries are not well injected and no arteries can be seen in the figure. Some of the potential spaces of the deep stratum are injected.

The injection was made after the septum was removed. The lining was pierced with a small hypodermic needle. The point of the needle was moved sidewise and back and forth in an effort to cut or break some of the deep vessels. India ink was then injected into the deranged tissue. Only a part of the deep stratum of potential spaces became injected. Ink was then injected directly into the lumen of one of the veins of the greater network of the superficial stratum (Fig. 1, SS). After the specimen was cleared, the lining (including the periosteum) was removed and the portion shown in Fig. 27 was separated from that shown in Fig. 26. The specimen was then photographed by using transmitted light and an ordinary photographic plate.

Fig. 27. A superficial layer of tissue from the upper portion of the nasal lining shown in Fig. 26. This layer contains principally some vessels which originated from the embryonic AVAs. One slender artery, including some of its branches became injected. Ordinary photography. Transmitted light.

Fig. 28. This figure shows the features of some of the relatively simple veins in the specimen presented as Fig. 27. One small artery and a small number of capillaries can be seen. Fig. 28 is from the rectangular area in Fig. 27. Ordinary photography. Transmitted light.

Attention should also be given to the fact that the nasal lining is a terminal blood station into which arterial blood flows from many directions and from which venous blood escapes through various channels in which the blood pressure is lowest. Arterial blood enters the lining of the nasal septum from the dorsal and ventral margins but especially from its posterior and anterior regions.

AVA is a relative term. If two blood vessels are connected with one another by means of an anastomosis this vessel becomes an arterial anastomosis in case the two vessels become arteries, it becomes a venous anastomosis in case the two vessels become veins, it becomes a pseudo-arteriovenous anastomosis (PAVA) in case one of the vessels becomes a typical artery and the other becomes a vein-like artery, it likewise becomes a PAVA in case one of the vessels becomes a typical vein and the other becomes an artery-like vein, and it becomes an AVA in case one of the vessels becomes a typical artery and the other becomes a typical vein. If a vein, an artery, an AVA or a PAVA conducts either arterial or venous blood primarily it persists without undergoing metamorphosis, but if it conducts the proper mixture of arterial and venous bloods to promote rapid proliferation of the cells in its walls it undergoes metamorphosis to form capillaries and some other small vessels. Relative stasis of arterial blood in an AVA or any other young anastomosis also promotes metamorphosis of the vessel.

In view of the circumstances that arterial blood flows to the nasal lining of the prenatal mammal from various directions and that the vascular strata in the lining are connected with one another by means of numerous vertical and relatively vertical anastomoses, the question arises as to whether the middle stratum or the superficial one will receive the greater amount of the incoming blood. If the greater amount of this blood flows into the middle stratum, as it does in a prenatal V/A mammal, the vessels of this stratum become arteries. The blood can escape from this stratum by flowing through many vertical and relatively vertical anastomoses into the superficial and deep strata in which the blood pressure is relatively low. The vessels of the superficial and deep strata accordingly become veins. In the prenatal A/V mammal, however, there are some anastomoses which elevate so much of the arterial blood from the middle stratum into the superficial one immediately after this blood enters the nasal lining that the vessels of the greater part of the superficial stratum become arteries. The anastomoses which elevate the arterial blood may be called arterial elevators. The deep stratum is associated with the superficial stratum by means of so many large and small anastomoses that the vessels of the deep stratum also become arteries. The

blood in the superficial and deep strata flows principally into the middle stratum via numerous vertical and relatively vertical anastomoses. The vessels of the middle stratum accordingly become veins. The blood escapes from the middle stratum by flowing through some venous elevators into vessels of the superficial stratum slightly beyond or peripherally to the points at which the arterial blood is conducted into the superficial stratum by means of the arterial elevators.

The arterial and venous elevators exist in the regions of the physiologic transition. The arterial elevators elevate arterial blood from the middle to the superficial stratum and the venous elevators again elevate this blood from the middle stratum into the superficial one after the blood has made a circus movement through many vessels and has become relatively venous. These elevators would have been ordinary AVAs which would have undergone metamorphosis if they had not served the purpose of elevating the arterial and venous bloods. The other anastomoses in the vicinity of these elevators contain a relatively static mixture of arterial and venous bloods, and they accordingly metamorphose into capillaries and certain other small vessels.

I am indebted to Mr. L. C. Massopust, of the Department of Art and Photography, for his painstaking care in photographing the specimens.

SUMMARY AND CONCLUSIONS

Mammals may be divided into two rhinangiologic types. The nasal lining of each type contains three horizontal strata of blood vessels. A mammal in which the superficial stratum conducts venous blood and the middle stratum conducts arterial blood is a V/A mammal. This means that the veins are above the arteries when only these two strata are considered. This is true in the mucous lining and the skin outside the nasal passages as well as in the nasal lining. The deep stratum conducts venous blood during prenatal and early postnatal life, but this stratum consists of mere potential spaces or functionless "ghost" veins in the adult V/A mammal. The deep stratum is connected with the other two strata by means of many vertical and relatively vertical venous and arteriovenous anastomoses. All of these anastomoses vanish. The superficial and middle strata are connected with one another by means of many vertical and relatively vertical arteriovenous anastomoses (AVAs). These AVAs undergo complete metamorphosis to form the general network of capillaries, the venocapillary anastomoses and the arteriocapillary anastomoses or postreticular endarteries. In some V/A mammals capillaries also originate from some of the veins of the superficial stratum. Aside from the

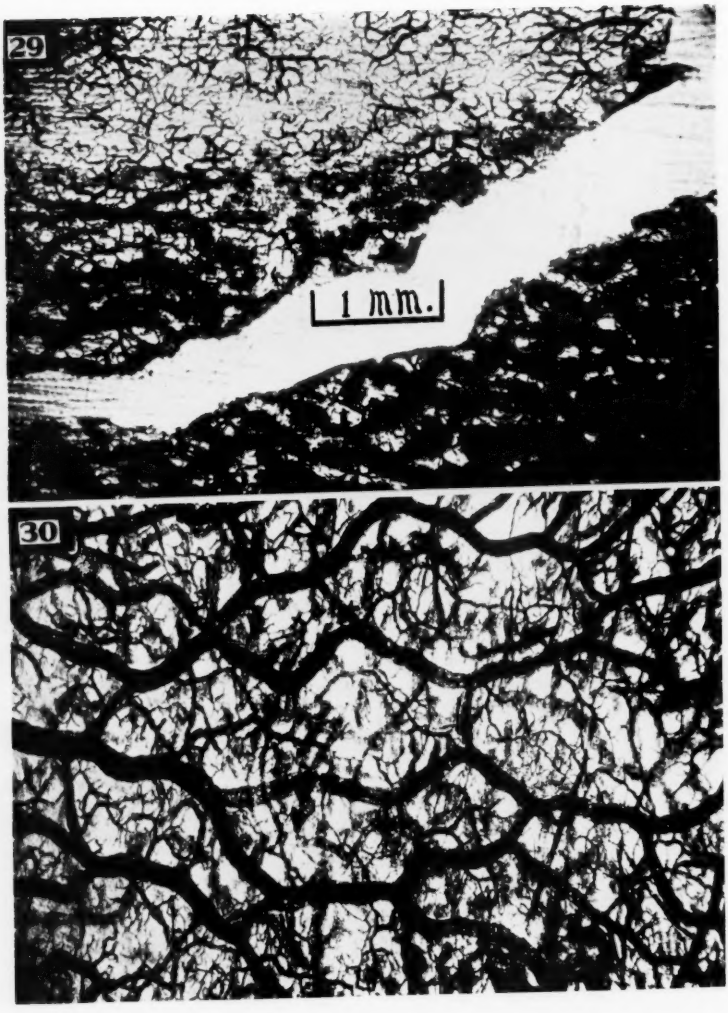
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Fig. 29. This figure is from the rectangular area in the upper right corner of Fig. 26. In the upper part of Fig. 29 mainly the periosteum and some small veins closely associated with it can be seen. These small veins can be detected at almost all points in the figure. The potential spaces of the deep stratum are well injected in the lower part of the figure. The small veins are not connected with the potential spaces. Arteries and capillaries cannot be seen. The superficial stratum of veins was removed. Ordinary photography. Transmitted light.

Fig. 30. The lesser and greater reticulae of the superficial stratum (Fig. 1, SS) became well injected. A small number of capillaries and some parts of one slender artery became injected. This artery is not a part of the middle stratum (Fig. 1, MS). It is more superficial than the superficial stratum (Fig. 1, SS). It is one of the vessels which developed from an embryonic AVA. No part of the middle stratum of arteries can be seen. The deep stratum of potential spaces became injected at all parts of this portion of the lining. The similarity of the most conspicuous veins in the figure to the vein-like arteries in some parts of the A/V lining of some of the A/V mammals is truly remarkable. Ordinary photography. Transmitted light.

typical V/A mammals there are some slightly atypical ones which can be grouped into subtypes. The subtypes were not discussed.

An A/V mammal is one in which the superficial stratum in the greater part of the nasal lining conducts arterial blood and the middle stratum in the same part of the lining conducts venous blood. In the mucous lining and skin outside the nasal passages the V/A type of circulation exists as it does in the typical V/A mammal. In the A/V mammal, however, a physiologic reversal from the V/A to the A/V circulation takes place in the nasal lining at the posterior and also the anterior region of each nasal passage. The deep stratum consists of arteries. Either all or only some parts of this stratum persist throughout life. This stratum is connected with the other strata by means of vertical and relatively vertical arterial and arteriovenous anastomoses (AVAs). The arterial anastomoses persist as helicine arteries. The AVAs undergo complete metamorphosis to form capillaries, venocapillary anastomoses and postreticular endarteries. The superficial and middle strata are connected with one another by means of many vertical and relatively vertical AVAs. These are especially abundant in the regions of the physiologic reversal. Some of these AVAs elevate blood from the middle stratum into the superficial one and are responsible for the physiologic reversal. These were called arterial and venous elevators in order to distinguish them from the other anastomoses which metamorphose into capillaries, small veins and small arteries.

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LIII

A STUDY OF NUTRITION IN RELATION TO INFECTIONS OF THE UPPER RESPIRATORY MUCOUS MEMBRANES*

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In the late fall four years ago the Department of Otolaryngology in the Medical School of Washington University gave me an opportunity to begin a study of the nutritional status of a few individuals with persistent chronic nasal sinusitis and mastoiditis which had not responded to the usual treatment of such conditions. The first case studied was a 14-year-old girl who looked fairly well nourished, but the condition of her teeth and gums was highly indicative of malnutrition. She had been advised two years previously by the pediatric clinic to take a regular diet and cod liver oil, and later to take a high caloric diet and cod liver oil. But there had been no attempt to teach this 14-year-old girl what she needed to eat for normal health.

The first case of chronic otorrhea was seen later in the same year. This little girl was of school age but could not go to school because she was hard of hearing and she could not play outdoors with other children because activity of any kind resulted as a rule in elevation of temperature. This 6-year-old girl did not look malnourished, but her teeth and gums showed definite evidence of malnutrition. She had suffered from earaches since her first year of life and treatment had been almost continuous during this period.

The nutrition in both of these individuals was inadequate. Food habits were unsatisfactory due both to poverty and to lack of understanding of food needs. The malnutrition was apparently not due to inadequate food nor to a lack of any one factor in the diet but to an inadequacy of perhaps all of the protective food factors. There was no indication from the nutrition histories of these two patients that vitamin A was the outstanding limiting factor of the diet. These patients lived in an environment where little thought was given to food except to satisfy hunger. And in both homes there was an

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economic problem, so that the least expensive foods were served. Neither patient had a good appetite. The diets were in both cases low in vitamins, particularly vitamins B and C, minerals and protein.

At the time these patients were first seen the only food factor which had been studied and emphasized to any great extent in its relation to infection was vitamin A. In 1923 Daniels et al., had demonstrated suppurations in the nasal cavities, sinuses, and ears of rats on a diet deficient in vitamin A, and for a number of years there was noted in human beings a marked interrelationship between food vitamin A and incidence of respiratory infections. Milk, cream, butter and cod liver oil were the then recognized best sources of vitamin A, and the use of these foods in greater abundance seemed to be definitely related to the incidence and eradication of mucous membrane infections. During the past years, however, it has been recognized both in human beings and in laboratory animals that vitamin A alone is neither the cause of nor the cure for nasal, sinus, or mastoid infection. As Marriott said, "Vitamin A is not the whole story nutritionally in relation to infection."

During the period of 1934 to 1936, in the rat colony at the Oscar Johnson Institute, rats were fed on diets adequate in all factors except protein. These rats at autopsy had pus in the nose, sinuses and ears. Rats were also fed on diets complete in all respects except calcium. Again at autopsy pus was found in the nose, sinuses and ears. Rats receiving adequate vitamin A also showed pus in the nose, sinuses and ears, and it was impossible always to cure this condition simply by adding more vitamin A to the diet of these animals. The conditions here described are not similar to the extensive infections which occur in the mucous membranes of rats on a diet free of vitamin A. Such suppurations, it was found, however, can be markedly decreased and delayed days or even weeks if the rats receive a diet reinforced with a concentrate of the vitamin B complex factors.

Observations made by Tilden and Miller[3] and Hetler[6] indicate that monkeys depleted of vitamin A do not usually show infections of the upper respiratory membranes. Tilden and Miller fed diets so low in vitamin A that keratinization of epithelial structures was apparent in many of the monkeys under observation, and yet there was no sinusitis or mastoiditis. Although there was some infection in some of Hetler's monkeys, the two animals that lived the longest and showed the greatest amount of keratinization of epithelial structures had tongue glands, sinuses and mastoids that were entirely free from pus. It may be significant to note that the monkey (Hetler's) that lived the longest and showed corneal ulcers of vitamin A defi-

ciency and yet no sinusitis or mastoiditis was fed a diet reinforced with yeast and tomato serum ad libitum for vitamins B, G and C whenever there was loss of appetite or loss of weight. Guinea pigs reported by Hetler[6] also showed almost no infection along with typical keratinization of epithelial structures due to vitamin A deprivation. These animals were given much more vitamin B and vitamin C than are required in a diet adequate for normal growth and health in the guinea pig. Guinea pigs receiving inadequate vitamin C are now known to be much more susceptible to infections, particularly to tuberculosis, than they are when receiving an adequate diet. And human beings with tuberculosis or with infectious diseases such as pneumonia, typhoid fever and also cancer and diabetes have a greater need than normal human beings for vitamin C. During the past year Hetler, Buhrmester and Wenner found that blood vitamin C decreases during the infectious diseases influenza and whooping cough, unless the diet is reinforced with more vitamin C than is required for normal health. In his recent book on vitamins, minerals and hormones Matthews[8] states that the part which vitamin C plays in the mechanism of protection against infections must not be overlooked. And Sherman[4] in 1937, states, "The absence of scurvy does not prove that the food is supplying all the vitamin C that the body needs for its best of health and vigor." Special study was made of the vitamin C of the diet, urine and blood of some of the patients followed in this study. Although vitamin C was found to be a limiting factor in the diets of most of the patients seen, this food factor was by no means the only limiting factor in the nutrition program of most of the patients studied.

During the past three and one-half years nutrition histories have been studied on over 300 patients in the nose and throat clinic at Washington University School of Medicine. These individuals ranged in age from five to sixty years. Although many of these patients were clinic patients and came from low-income families, a fair percentage of the individuals studied enjoyed a high standard of living. The patients whose nutrition was studied came to the clinic either because of persistent chronic nasal sinusitis, chronic discharging ears, or a combination of nasal and ear infections; because of an allergic manifestation of the upper respiratory tract, persistent headache, or a combination of allergy and infection. The general health of most of the individuals studied appeared fairly good. As a rule they did not look sick and without careful examination of the nutrition histories of these patients, it might have been said that their nutrition needed no supervision. On the other hand, a thorough study of food habits, environment influences, sleep, rest, relaxation, adjustment to a

satisfactory schedule and nutritional history, along with manifestations of inadequate nutrition, made it necessary to recognize that all of these individuals needed help in improving their present nutrition programs. Although many of the individuals came to us primarily because of upper respiratory involvement, a number of the patients had chronic constipation; many had dirty mouths with bleeding gums or decaying teeth or both; many of them had very poor appetites and were never hungry; some were sleepless; a few patients complained of sensitivity to light; many of them had muscle or joint aches and pains, and a few had low basal metabolic rates. In reviewing nutrition histories with these patients it was apparent from the first that several common conditions were occurring in each case. In the first place almost always there had been some period or periods in the lives of these individuals when the food intake had been inadequate for the existing condition. For example, one of the most severe infections studied followed a prenatal period of excessive nausea and vomiting. Again one of the 6-year-olds had lived through several years of the "depression" when the mother now admits she did not have adequate food for the child and did not know how to spend her food money in the best possible way. One of our mothers admitted that she had all the government bulletins on child feeding and care and excellent medical supervision, but the girls just wouldn't eat the food she prepared for them. Finicky food habits, food fads, elimination diets, economic stress, unfortunate physiological conditions, nutritional ignorance or indifference thus appeared as factors which showed an influence on the health pictures of all of the patients studied.

In reviewing food habits of all of the patients studied, there was one food nutrient in particular that appeared to be universally in lowest concentration in the diets and a second and others which were inadequate for optimum health. The vitamin B complex factors, and particularly vitamin B, was never found present in the diets of these patients even in the minimum amounts suggested by Cowgill.[5] And the minimum amount of vitamin B was due to the fact that so many individuals studied were using rather large amounts of sugar and white flour products in proportion to their total calories. Most of the children studied had taken or were taking some milk, but the fruit and vegetable intake, except potatoes, apples and bananas, was very low. Most of the patients used meat, eggs and refined cereals, but the meat and eggs and milk were often limited in amount either because of income, prejudice, preference or food eliminations, and thus the diets were often found low in protein. Raw fruits and vegetables and particularly citrus fruits and tomatoes were found to be

used in minimum amounts by almost all of the patients studied, so that vitamin C usually appeared as the second outstanding limiting factor in the diets. This low condition of vitamin C in the diet and in the tissues has been checked by Hetler, Buhrmester and Wenner during the past year by blood and urine analyses, which agree very well with conditions apparent from dietary histories. As a rule vitamin A did not appear to be an outstanding limiting factor of the food needs. Many of the children studied had taken or were taking cod liver oil and whole milk, butter and eggs. The adults, too, often had used some form of vitamin A concentrate so that with the foods taken and the vitamin concentrate used only a few of the patients studied were using less than 3,000 units daily of vitamin A and a few of them had been taking as much or more than 6,000 units daily. One of the most stubborn cases of infection came to us with a history of a satisfactory intake of milk and cod liver oil. Only a very few determinations for vitamin A of tissues were made with the biophotometer. The mineral content of the diets varied considerably from standard, but with few exceptions there was found no outstanding inadequacy in calcium, phosphorous, iron or iodine. Diets were sometimes distinctly acid in reaction, but this was by no means a general observation. The low content of vitamin B complex, particularly vitamin B, and the low content of vitamin C in the diets were then the outstanding and universally consistent conditions in the food habits of practically all of the patients studied.

The third very significant observation made in this group of individuals in relation to their nutrition programs was the irregularity with which they chose their food both in relation to kind and amount and relation to the time when they wished to eat. Several of the children studied had been to a farm where they had had special supervision of their diets for a limited short period of time, but in each case on returning home the child had again routined him or herself on the old schedule of irregularity in kind and amount of food eaten and whatever progress had been made at the farm was soon lost. Adult schedules were found to be just as irregular and inconsistent as those of the younger patients.

Previous nutrition inadequacies, present dietary inadequacies and the time when and amount of food eaten thus appeared to be the outstanding nutrition problems presented by this group of individuals. And the possibility of a good result in improving nutrition depended almost entirely on the willingness of the patient to cooperate in a new program not for one or two weeks or months but perhaps for as many years. The first case studied, in 1934, had been

under observation for over two years before any intensive nutrition work was begun. The patient was then 14 years old, had a chronic purulent sinusitis, a productive cough, antral windows had been made, the tonsils and adenoids removed, an allergic study had been made, treatments were given frequently but the condition did not improve. Nutrition work was begun in late October, 1934, and although the patient was fairly co-operative there was no improvement until May, 1935. The patient had a very dirty mouth and fourteen carious teeth. These conditions were taken care of in December, 1934, and since that time the teeth have never needed cleaning. During the past two months four small cavities were repaired. Most of the improvement in this case has been brought about by changes in food intake with only a minimum use of vitamin or mineral concentrates. Some yeast concentrate has been used and a minimum of viosterol and calcium lactate were given during the first winter. The patient did learn to have four satisfactory meals during the day. She used milk and cheese, eggs, meat, particularly liver and heart and kidney, daily. She used citrus fruit or tomatoes with each meal unless the meal included raw cabbage. During March, April and May she drank one quart of tomato serum daily. She used carrots or cooked dark green leaves every day. She used oatmeal or whole wheat or corn cereal daily. It was impossible to use whole grain breads to secure satisfactory vitamin B, so the patient was given the yeast concentrate. After her first improvement she was seen irregularly for several months and in the fall of 1935 there was minimum recurrence of pus in the nose. The food habits were unsatisfactory again, particularly because of inadequate income. Changes in food habits to increase vitamins B and C, however, resulted in an improvement in the condition of the nose. Reverses have come repeatedly in this patient's family but the patient still carries on with her diet so that the sinus condition is satisfactory. The cough has almost ceased, is no longer productive, she has very few colds, and she appears very well. Throughout her treatment this patient has had a leucocytosis. The white count was 26,000 in 1934. It is now 10,000 to 16,000. This patient is not in optimum nutritional condition. Home conditions and the economic situation have made it necessary to carry on an educational program for best nutrition under the existing conditions rather than for an optimum program. But for the most part the co-operation has been good and the result is satisfying. During the period from October, 1934, to June, 1935, the patient was treated by displacements with one-half per cent ephedrine, the nose was cleaned by suction, and the patient used some one-half per cent ephedrine and some five per cent argyrol nose drops.

Where funds are adequate for vitamin concentrates and the patient is willing to take both foods with the greatest protective value and vitamin and perhaps mineral concentrates, sometimes it has been possible to secure a good result in a period of three to four months. This was true of an adult in her early twenties during the past winter. She came to us with chronic sinus condition and was thought to be allergic. By tests she showed positive nasal mucosal reactions to a number of foods, but finally showed disturbing sensitivity only to tomato. Her meals and hours had been very irregular although her food habits had occasionally been fairly good. She was the type of person who could gain or lose weight fairly easily and had done so by eating excessively for short periods and then dieting because of lack of interest and understanding of food needs. She was also interested in so many activities that she was tired most of the time. When a satisfactory breakfast and three other meals were suggested to her along with vitamin concentrate, her suffering from repeated sinus attacks alone encouraged her even to listen. She did try our program though and has had a very comfortable winter. She has used vitamin concentrates daily. Her appetite has been good. She says she enjoys cooked cereal, egg, citrus fruit and milk for breakfast. And the other irregularities of her diet have been adjusted. The result in this case was excellent for about six months. There is now some recurrence of the infection.

The allergic patient who has infection usually presents difficult problems, because he or she is usually sensitive to the foods most needed to help to remove the infection. This was true of one of our patients who for six years has been uncomfortable in all climates. When she came for nutrition help she was losing weight, was constipated, was very unhappy, and showed no interest in any suggestions made to her. Tests for sensitivity showed her to be allergic to a long list of foods and left a minimum of foods from which to choose an adequate and satisfying diet. It was possible, however, to reconstruct a plan for three satisfying meals for her, and with vitamin and mineral concentrates her condition showed slow improvement. The constipation cleared, she gained enough weight, the basal metabolism increased from —17 to —9 and the post nasal infection began to improve. She is sensitive to milk but can take some cream. She is sensitive to wheat but can use rye, rice and corn. She is sensitive to many fruits and vegetables and to some meats. But by using a rather large intake of vitamin B concentrate, 1,000 to 1,500 Sherman units daily, she maintains a good appetite and enjoys her improvement. Her gum condition was rather serious a year ago, but the dentist reports a constant and satisfactory although slow improvement. She

takes not only vitamin B concentrate daily but also calcium gluconate and vitamins A, C, D and G in moderate amounts. She has tried many different kinds of concentrates until we have found the food concentrates and the foods which help her to be most comfortable. The report of the mucous membrane of her nose by Dr. L. W. Dean was: "I didn't suppose it could ever look as well as it does." Treatment in this case has consisted of displacements with one-half per cent ephedrine once or twice weekly when the patient was particularly uncomfortable.

Two patients with edematous nasal mucous membranes, sisters whose nasal pathology has been long standing and very resistant to treatment of any kind, have presented difficult problems. At first they were thought to be allergic, but after being studied for some time, as Dean et al.[9] reported in 1937, these cases have proved not to be allergic. These patients are now 17 and 21 years of age. The younger one has been under medical care for the condition of her nose since she was seven years old. She has been operated on numerous times and the nose has been ionized once on both sides and once on just one side. When she came for nutrition study in December, 1934, she had chronic purulent sinusitis, bronchiectasis and severely bleeding gums. Her teeth were and are without decay. Her skin showed severe acne. She had dysmenorrhea. The diet was satisfactory in all respects except vitamins C and B. She had always taken at least a quart of milk daily and always a tablespoonful of cod liver oil daily. She had eaten quantities of refined cereal foods and some candy. She did not use whole grain cereals. She used almost no fruits or vegetables except legumes and stewed fruits. All citrus fruits, her mother said, she had always refused. Unfortunately at that time the vitamin C content of blood and urine was not determined. It required at least six months to teach this patient better food habits. She showed sensitivity to milk, so this was excluded from her diet for some months without a good result. In February, 1935, there was no improvement either in the color of the mucous membrane or in the breathing space of the nose. After several weeks of small unmeasured doses of vitamin C concentrate by mouth the condition of the nose showed some improvement. This patient did not gain weight even with improved food intake until cortin injections were given two times weekly for several weeks. After October of 1935, there followed ten months of minimum nutrition supervision. The patient lost ten pounds and the condition of the nose became very much worse again. The gum condition and the skin in the fall of 1936 were still very unsatisfactory. The food habits had remained fairly satisfactory, adequate but not optimum. In November, 1936, the

blood vitamin C was determined. Although the diet of this patient had included an equivalent of sixteen ounces of citrus fruit and tomato in addition to raw vegetables daily for a period of almost two years, the blood vitamin C was only 1.0 mg. per cent. Normal individuals usually show a blood vitamin C of 1.3 to 1.6 mg. per cent on a similar intake of vitamin C. To attempt to increase the blood vitamin C this patient took 100 to 200 mg. of vitamin C concentrate* daily in addition to her food vitamin C and in addition was given 1,000 mg. vitamin C by intramuscular injection in ten 100 mg. amounts. During the last of January she had influenza. The intramuscular injections of vitamin C and the Cebione were discontinued during the two weeks of influenza but the food vitamin C was continued. On February 4 the blood vitamin C was again determined. The blood vitamin C had decreased from 1.0 mg. per cent to 0.8 mg. per cent, and the condition of the nose was worse. Vitamin C was continued in food and vitamin C concentrate was taken in amounts of 100 to 200 mg. daily, but even with this high intake, on February 9 she excreted only 10.3 mg. vitamin C in the 24-hour urine elimination. A normal individual on the same previous intake of vitamin C would be excreting 75 mg. vitamin C or more in the 24-hour urine elimination. The next day this patient excreted 184 mg. from a test dose of 640 mg. of vitamin C. This observation indicated that her tissues were probably not saturated with vitamin C. The next day she began to take 500 mg. daily of vitamin C in food and concentrate and continued this until February 26, when a sore throat occurred, at which time she stopped the vitamin C concentrate but continued her food vitamin C. By February 23 the gums were much improved and the nose showed marked improvement. The blood vitamin C was 1.2 mg. per cent and she excreted 342 mg. of a 600 mg. test dose of vitamin C. During March the patient was irregular in the intake of vitamin C concentrate but continued to ingest at least 200 mg. daily. On March 23 the blood level was still 1.2 mg. per cent but the urine excretion was only 18.7 mg. of vitamin C, a lower value than normal with an intake of 200 mg. On March 29 she excreted 220 mg. from a 500 mg. intake, this intake having been continuous daily since March 23. At this time the nose, according to Dr. L. W. Dean, looked the best that it had ever been. The vitamin C blood level of this patient has not yet increased to normal in relation to her vitamin C intake. She has gained 13 pounds in the last ten months, During 1934, 1935, 1936 and 1937 this patient has taken vitamin A, B, D, G concentrate almost daily. Her food intake has included milk, eggs, glandular organ or muscle meat daily,

*The vitamin C concentrate, Cebione, was contributed by Merck and Co.

whole grain cereals, cooked fruit or vegetables at two meals and raw fruit or vegetables at three meals, with especial emphasis on colored fruits and vegetables, and eight ounces two times daily of citrus fruits or tomato juice. Most of the time she has eaten four meals a day. The general physical condition of the patient is now good. The nose is much improved but it is not well.

The older sister, whose nasal and lung conditions resemble those of the patient just described, has been seen for intensive nutrition work only during the past year. Her gums and teeth indicated malnutrition. Her diet was fairly satisfactory, but not optimum. Her diet was high in refined carbohydrate, so she needed vitamin B. In October the blood vitamin C was only 1.0 mg. per cent even though her diet had included 100 to 150 mg. vitamin C daily in the food for at least six months. Determinations of vitamin C excretions were not made on this patient. On October 24 she began to take 200 mg. daily vitamin C concentrate plus her food vitamin C and was also given 200 mg. vitamin C intravenously for five days. The high vitamin C intake was continued until November 18, when she showed a skin rash with severe itching over the entire body, which was relieved when vitamin C concentrate was discontinued. On November 23 the blood vitamin C was 1.1 mg. per cent. The nose condition continued the same with a constant thick secretion and pale bluish colored edematous nasal mucous membrane. On December 12 she again began to take 200 mg. vitamin C concentrate by mouth, but had to reduce this to 100 or less mg. daily to prevent the skin rash. Intravenous injections of vitamin C were discontinued until February. Her nose condition, however, was growing worse so the vitamin C was again increased. She took 100 to 200 mg. vitamin C daily in her food, and an intravenous injection of 200 mg. of vitamin C two times weekly for a period of more than three months. There was no skin rash. On May 20, the nose was remarkably better and on May 26 the blood vitamin C was 1.5 mg. per cent. This patient has taken adequate vitamins other than vitamin C in her food. She had some vitamin A, B, D, G concentrate for six to eight weeks during the winter. But she has not been too co-operative in taking vitamin concentrate and thus stress has been especially for vitamin C. The cough (bronchiectasis) which had been persistent is very much improved. The color of the nasal mucous membrane is good and there is a minimum of secretion. The patient reports that she feels fine. Whether or not this vitamin C blood level will remain at 1.5 mg. per cent without constant very high intake of vitamin C both by mouth and by intravenous injection is unknown. Vitamin C will be given by intravenous injection until July 1 and then will be dis-

continued temporarily to be again resumed if needed to maintain the better nutritional status and condition of the nose of this patient.

The case of a 13-year-old girl with chronic infection of the ears and nose and with bronchiectasis was seen in August, 1936. Her food was too low in protective factors and her appetite was so poor that a good result was necessarily delayed. The vitamins of her diet were increased so that she was soon receiving 100 to 150 mg. daily of vitamin C. In December the blood vitamin C was only 0.7 mg. per cent, three months after the vitamin C intake had been markedly increased. By giving 300 mg. of vitamin C daily the blood vitamin C increased to 1.5 mg. per cent by January 29, and this level was easily maintained so long as the vitamin C intake remained at 300 to 400 mg. daily. In March the vitamin C intake was decreased to 100-150 mg. again and in two months the blood level was 1.27 mg. per cent with a 24-hour urine elimination of only 12.1 mg. Her condition had improved so that the ears were dry, the nose more satisfactory, and the cough less, but with the decreased intake and blood level of vitamin C the ears are again running. This patient apparently needs at least 300 mg. daily of vitamin C to keep her in vitamin C equilibrium so long as the infection of the nose, ears and lungs persists. During the past year this patient has had a satisfactory but not optimum food intake and has taken vitamin A, B, D, G concentrate daily. She will continue her present better plan of food intake, vitamin concentrates, rest, sleep and regularity in her nutrition program. And a plan has now been made to give this patient for the next three to six months a series of intravenous injections of vitamin C.

A history of the nutrition condition and changes in the nutrition program has been given for only a few of the cases of infection studied. Similar nutrition conditions, however, were seen in many of the patients followed, although each individual studied presented different nutrition problems. In the few patients here discussed there was seen, according to Dr. L. W. Dean, definite improvement in the condition of the nasal mucous membrane and a decrease or elimination of pus in the nose, sinuses and ears when the improvement in the nutrition program was accomplished and followed. Although there is some evidence that the increase in vitamin C and vitamin B in the tissues may be in part responsible for some of the improvement in the condition of the infection, it seems more possible that the combined effect of all of the essential factors of better nutrition contributed to the improved condition. Of the more than 300 patients studied, there was improvement in the condition of the mucous membrane of over 90 per cent of the individuals seen. A few of the patients were

so unco-operative that a good result was impossible. Two of the patients were fairly co-operative, but there was no improvement in the condition of the nose.

It appears from the results here reported that nutrition is an important factor in the treatment of chronic infection of the nose, sinuses and ears. A change in the nutrition program is necessary not only in the kind and amount of food eaten but also in the control of all of the environmental factors which may in any way influence the enjoyment and utilization of food. The success of the nutrition program depends of course upon the patient. The patient must be sufficiently interested and intelligent concerning nutrition needs, so that he or she can plan the program and carry it on independently. The nutritionist must, therefore, analyze thoroughly with the patient the nutrition history, the patient's food habits, food likes and dislikes, food budget if necessary, and the health habits, so that help can be given to the patient to better understand food needs in relation to health. Foods can be grouped rather simply so that the patient can plan meals to include in every meal some vitamins C, B, A, D and G, some satisfactory protein, and enough carbohydrates and fat to satisfy appetite and take care of caloric needs. Body weight is important only as a check on adequate quantity of food eaten and should not be given too much consideration. The time when meals are eaten is important as is also the interval between meals. Some individuals do very well when they eat only three meals a day. Very occasionally two meals a day are satisfactory. But more often the most satisfactory plan is for four or five meals a day spaced at three or four hour intervals and at the same and regular intervals every day. Children, it has been found, often show marked improvement in their nutrition condition if they have a dinner at 4:30 rather than to wait until 6:00 or 7:00 to eat with the family. A lunch after school often interferes with the appetite for dinner and the lunch is seldom a satisfactory meal. The amount of food needed and enjoyed by different individuals at meal time is often a determining factor in planning the number of meals and interval between the meals. And the amount and kind of food which the individual will eat and enjoy is usually a determining factor in deciding the need for vitamin and mineral concentrates. The nutrition history, the nutrition condition, the economic status and the adaptability of an individual to food needs are determining factors in a plan for a better health program. Food alone without vitamin and mineral concentrates can be satisfactorily chosen to meet all food needs. But carbohydrate foods have been so refined that much of their vitamin B is lost. And food is cooked so that again much of both vitamin C and vitamin B may be destroyed

or discarded. Mineral and vitamin values differ in the same kind of food grown in different kinds of soil. And different varieties of the same kind of food differ in content of protective factors. It is thus difficult to insure adequate nutrition, particularly in a malnourished individual, without the use of food concentrates. And for the allergic person who must omit some of the very essential foods such as milk, eggs, wheat, citrus fruits and tomatoes, it has been found very necessary to supplement the diet with vitamin and mineral concentrates.

SUMMARY

The nutrition history and the nutrition condition was studied in over 300 patients from the clinic of otolaryngology in the Medical School of Washington University. These patients came to the clinic because of persistent chronic nasal sinusitis, chronic discharging ears, or a combination of these infections; or because of allergic manifestations of the upper respiratory tract, persistent headache, or a combination of allergy and infection. One patient was followed for a period of four years. Other patients were followed for a period of six months to one, two, or three years. All the patients seen were in need of an improved nutrition program. Their food habits indicated inadequate protective factors, especially vitamins B and C, minerals and protein. Their meals were very often irregular both in the kind and the amount of food eaten and in the times of eating. Rest, relaxation and outdoor activity were often very inadequate. Many patients had adequate or liberal incomes, so that money was not always a limiting factor in the incidence of the condition studied.

Although it was difficult to secure optimum co-operation from all of the patients in improving the nutrition program, it was possible to help many of the patients studied to carry on a more satisfactory plan of food intake, sleep, rest, regularity and activity. And whenever there was improvement in the nutrition program it was found that in three to six months improvement was occurring in the condition of the nose, sinuses and ears. Often the patient appeared entirely free of infection. When the improved nutrition program was discontinued, however, there was usually a return of the infection.

A brief resume is presented to show that infection in the nose, sinuses and ears in animals does not follow any one dietary inadequacy, but rather may be expected with the lack of almost any essential factor of the diet.

The diets of the patients studied differed in the incidence of inadequate protective factors, but the most common inadequacies found were vitamin B and vitamin C. Many diets studied lacked

optimum vitamins A, D and G, calcium and iron and protein. Very occasionally calories were found to be a limiting factor in the food intake. An attempt was made to help the patient select food so that food furnished the necessary protective factors if possible. And if the patient found it difficult to use the right kind and amount of food for optimum nutrition, vitamin and mineral concentrates were used. Almost all of the patients who were allergic found it necessary to use some food concentrates.

Some data are reported to show that individuals with chronic infection have less vitamin C in the blood and urine than normal individuals who take the same amount of vitamin C in their diets. Also some data are presented to show that more vitamin C is needed by people with chronic infections than by normals to bring about an increase in the vitamin C content of the blood. One case is reported to show that blood vitamin C can be increased after three to four months of intravenous injection of this food factor when blood vitamin C increase failed during the time that vitamin C was given by mouth only.

There appears to be an improvement in the condition of the nasal mucous membrane after blood vitamin C has been increased and remains at a high level for several months.

Grateful acknowledgment is made to Dr. Lee Wallace Dean, to Dr. Alfred J. Cone, to Dr. Robert E. Votaw, to Dr. Braswell Collins, and to many other doctors in the clinic of otolaryngology in the Medical School of Washington University, for their patient co-operation in making this study possible.

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LIV

THE CLINICAL RELATIONSHIP OF INFECTIONS IN THE UPPER RESPIRATORY TRACT TO CERTAIN TYPES OF CHRONIC POSTERIOR UVEITIS: PART II.

(A Supplemental Report)*

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In a prior article[1] I submitted an analysis of the clinical records of 120 patients afflicted with chronic posterior uveitis of the type usually attributed to focal infection, in which an attempt was made to point out the relationship existing between this condition and infections in the upper respiratory tract and emphasize the importance of such foci in its clinical course.

Subsequent to the time the original report was made, a larger series of clinical records of patients with chronic posterior uveitis has been reviewed and subjected to an analytical survey. The number of patients involved in the latter analysis is 230, and includes all records which were in the original group of 120 patients previously reported.

The type of uveitis with which we are concerned in this article is the insidious, low grade, essentially chronic type of inflammatory reaction involving the vascular structures posterior to the iris in which the principal etiological factor is regarded by many authorities to be one or more chronic foci of infection. In this type of chronic posterior uveitis the onset of the disease is usually of a painless character, associated with increased fluidity of, and exudate into, the vitreous. Various types of vitreous opacities occur, ranging from spider-web strands to veritable sheets of exudate. Asthenopic symtoms, photopsiae, and reduction in visual acuity accompany the condition, and there is usually more or less sensitiveness of the affected eyeball to palpation. Choroidal changes are often visible in the ocular fundus if the vitreous opacities are not too great.

The inflammatory reaction in the posterior part of the uveal tract may extend to the more anterior structures of the globe, and

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may also extend more superficially, either coincidentally or consecutively, giving rise to involvement of the ciliary body and iris with associated inflammatory changes, synechiae, deposits on Decemet's membrane, or in extension outward to produce evidence of scleritis. In this article, however, only those cases have been included in which the chief involvement was in the posterior segment of the eye, and where iris and ciliary body involvement has occurred in connection with posterior uveitis, it has been as a coincident or consecutive process, and was not used as the basis for classification of any of the patients included in this series. No instances of iritis or iridocylitis as ordinarily classified are considered in this article.

In the series of patients included in this survey, paranasal sinus infection was present in 94 patients, or 40.8 per cent, 65, or 28.2 per cent having the chief involvement in the ethmoidal group of sinuses, 14, or 6.09 per cent, in the maxillary sinuses, 10, or 4.2 per cent, in the frontal sinuses, and only 5, or 2.1 per cent, in the sphenoidal sinus. In the entire series there was only one patient with an acute exacerbation of a chronically diseased sinus. In this instance an acute flare-up involved a frontal sinus which had been diseased for a number of years. The association of chronic paranasal sinus disease and chronic posterior uveitis noted in this report, is in conformity with the experience of other observers, such as MacKenty,[2] de Schweinitz,[3] Thomson,[4] Zeim,[5] Everbusch,[6] and Fish,[7] who have pointed out that it is unusual for acute suppuration in the sinuses to produce uveal inflammation but rather the insidious, low grade, so-called concealed type of involvement. The monumental work of Rosenow[8] and his co-workers in clarifying the role of chronic local infections in the production of certain ocular disorders, such as uveitis, has done much to lift the veil of mystery surrounding such conditions, and to point the way to a better understanding of the relationship existing between focal infections and elective localization in structures such as the choroid.

The usual diagnostic methods were employed in establishing the diagnosis of paranasal sinus disease and where operation was performed, histological examination of the excised soft and bony tissue, with verification of the diagnosis, was obtained. In addition to the mucosal changes encountered there was quite often either a rarifying or condensing osteitis involving the bony walls of the ethmoidal and sphenoidal sinuses.

The average age of the patients in the combined series was 45 years, a reduction of one year from the average in the previously reported group, due to the occurrence of a greater number of young

individuals in the latter records of the combined series. The eldest patient was 86 years of age, and the youngest was 10 years. The greatest number of cases, eighty-six, occurred in the fourth decade of life. There was no apparent predilection for either sex, as the cases were almost equally divided. Thus it is evident that the disease, in this series at least, is chiefly one of adult life and is relatively rare in young individuals.

Chronic tonsillar infection was present in 94 patients, or 40.8 per cent, and some type of dental sepsis was present in 74 patients, or 23.97 per cent.

Chronic colitis was present in 57, or 24.8 per cent of the patients, and it was further noted that constipation was almost universally present in the patients included in this series. Involvement of the colon is, we believe, explainable on the basis that patients having a chronic upper respiratory infection will, by swallowing infected secretions over a long period of time, eventually develop a chronic colon infection. Other observers have noticed the frequency of this association, although some mention the fact only casually. Parkinson[9] has strongly emphasized the occurrence in an important paper dealing with the intestinal bacterial flora in chronic sinus disease. There may be some additional relationship between chronic colitis and chronic sinus disease from the allergic standpoint, as will be pointed out later in this article. It has been emphasized by several observers that allergic colitis is not an infrequent occurrence, and in the presence of the allergic state, is quite likely to occur as an affection concomitant with other phenomena of hypersensitiveness.[10 11 12]

Twenty-eight patients of our series were selected at random for intracutaneous uveal pigment tests. All the patients tested exhibited hypersensitiveness to the pigment. The response to this test varied from slight local reaction with mild erythema, to the more severe type characterized by induration, vesiculation, and ulceration about the point of injection. Nausea and vomiting, with rise in temperature, followed the skin test in two patients. Normal uveal pigment suspension made from beef eyes was used in the test, and control injections of 1:20 bovine serum were used to guard against false positive reactions. The test solutions were free from all types of preservatives, such as tricresol or phenol, having been prepared in such manner that they were sterile and, therefore, did not require them, which was an additional precaution used to guard against false positive reactions of chemical origin. It should be borne in mind that the entire series of patients was not subjected to the uveal pigment test for one reason or another, but, where it was employed, the

results were consistently positive and sufficiently well marked to lead us to believe that sensitization to uveal pigment plays an important röle in the pathological progression of chronic posterior uveitis. It is believed sufficiently interesting to state that in involvement of the anterior portion of the uveal tract, such as acute iritis, sensitization to the granule type of uveal pigment does not ordinarily occur.

It was the usual rule for sinus infection to be present for an appreciable length of time prior to the onset of the uveal inflammation, and according to an estimate based on the case histories of patients in this series, the duration of the sinus infection was slightly in excess of two years before ocular involvement was noted, placing all sinus infections in the chronic group. The difficulty in estimating this point precisely will be evident when one considers the fact that many patients cannot give an exact date of the onset of their nasal difficulty, and, therefore, the duration of the sinus infection cannot always be made with absolute accuracy. The usual type encountered was not the frankly suppurative type of sinus disease, but the low grade, so-called concealed type of disease, in which there is minimal discharge, but with definite and well-marked hypertrophic changes in the sinus mucosa and, quite often, alterations in the density of the bony walls of the involved sinus or sinuses.

Uveal inflammation can, according to authorities on the subject, be produced in two ways: either by localization of bacteria in the choroid with sensitization of the structures involved in the localization and the occurrence of an attack of uveitis at that time, or the inflammatory reaction may be abortive in character and no clinical change be noted in the eye, only the bacterial sensitization taking place. Bacteria may subsequently enter the circulation from an infective focus and come in contact with the sensitized structures and produce an inflammatory reaction after an interval of weeks or months through their contact with sensitized cells. Toxins from the same, or a related strain of organisms, may act in a similar manner in producing a reaction without the presence of bacteria in the eye at the time, through their absorption and subsequent contact with previously sensitized cells; and, thus, an allergic state is possible in which either bacteria or their toxins may act as the allergin to precipitate an inflammatory reaction in the previously sensitized structure. It further appears that the inflammatory reaction which is produced in the choroid acts on the uveal pigment present in the eye, causing a degree of absorption sufficient to induce, in addition, a sensitization to this substance. When the pigment-bearing areas are once sensitized, a secondary allergic reaction will occur wherever a similar type of

pigment occurs in the body, an involvement of the second eye follows in due time from the presence of the specific antigen in the form of uveal pigment being present in it, which probably explains the frequency of bilateral involvement in chronic posterior uveitis. In persons sensitized to uveal pigment, a local hypersensitiveness can be elicited by the specific antigen (pigment) if it is introduced into the skin. Absence of organisms from eyes examined microscopically, which have been the seat of an uveal inflammation, would indicate the probability of this sequence taking place. Elschnig,[13 14 15 16] Woods and Knapp,[17 18 19 20 21 22] have pioneered the work in the field of uveal pigment hypersensitiveness, and their work with uveal pigment in certain uveal disease, such as sympathetic ophthalmia, has revealed the presence of the allergic phase in this disease, in which the responsible allergin has been repeatedly dmonstrated as the type of pigment found in the choroidal coat of the eye.

Cataractous changes, usually bilateral, were present in the lens in 55 patients, or 22.6 per cent of the total. The frequent association of lenticular changes and uveitis inclines one to the belief that certain cataracts are the terminal event in a high percentage of patients with posterior uveitis. They are not always of the posterior polar type, but rather infrequently so in our experience. The frequency of this association indicates that certain types of cataracts occur in the course of chronic posterior uveitis which has its inception in focal infection, and in which there is an intermediate allergic phase associated with hypersensitiveness to uveal pigment. In a few instances, in our series, it has been possible to follow patients with chronic posterior uveitis over a number of years and anticipate the appearance of lenticular changes. The sequence of pathological events in posterior uveitis of the type considered in this paper, appears to be: first, focal infection; second, bacterial sensitization of the eye; third, inflammation in the choroid through the action of bacteria or bacterial toxins; fourth, absorption of uveal pigment and sensitization of the eye; fifth, pathological changes in the uveal tract and vitreous through the joint effect of bacteria or their toxins, plus the reaction due to uveal pigment; and sixth, in a certain percentage of patients, the development of lenticular changes which probably come about through altered metabolism of the lens in the allergic state.

Correcting the factors responsible for the attack of uveal disease usually brings the condition under control, and the course of the disease may be arrested at any point in the sequence of events noted above, so that the patient does not necessarily run the entire gamut of conditions enumerated.

Pigment similar in type to that occurring in the uveal tract is also found in the internal ear. The pigment encountered in the internal ear is in connection with the cells of Claudius, also in the base of ampulla, the stria vascularis, and in the walls of the semicircular canals. Its origin is embryologically identical with that of uveal pigment from the ectodermal tissues. Its structure is chemically the same as the granule type of pigment in the choroid, and, like it, is classified as melanin. It is present in melanophores somewhat similar to those found in the choroid. Alexander[22] has done a great deal of work on this subject, and his contribution deserves more attention and general reading than it has received. Vertigo and impairment of hearing, so often encountered in patients with chronic posterior uveitis due especially to paranasal sinus disease, may be, at least, partially explainable on the basis of an allergic reaction in the pigment-bearing portions of the internal ear due to a concomitant or consecutive sensitization of those areas. In our series, hearing impairment, usually of the nerve type, occurred in 28 patients, or 12.16 per cent, and was almost exclusively present in patients who had suffered from uveal disease over a period of years. Further investigation into this portion of the subject is anticipated, and will be reported at a later date.

It is not considered within the province of this paper to discuss the therapy of paranasal sinus disease, but emphasis is placed upon the fact that operations often leave residual infection which must be taken into account in an intelligent conduct of treatment, as failure in eradicating infection by operation calls for careful aftercare to minimize its effects. Half-way measures are not satisfactory. Secondary foci, due to prolonged ingestion of infected mucous or pus, such as that which so frequently occurs in the colon, must also be considered, for this area represents a zone of implantation and requires measures directed specifically toward it in order to be brought under control. Removal, or treatment directed toward, relief or ameliorization of the primary focus alone, is insufficient.

Throughout this series we have noted in general an agreement in the frequency of complications with those of the former series, except that there has been a slightly lower incidence of paranasal sinus disease in the complete series, and an increase in the percentage of lenticular changes noted. The former is explainable on the basis that there were several patients included in the complete series in which the responsible focus of infection could not be located.

This article is intended to correlate certain facts relative to the association of upper respiratory infections and chronic posterior

uveitis which can be utilized in treatment, with the view to shortening the period of disability which such conditions produce, and to point to certain problems in connection with this disease which will require clarification by further research.

CONCLUSIONS

1. Chronic posterior uveitis is due to focal infection in a high percentage of cases.

2. The responsible foci are usually located in the paranasal sinuses, tonsils, or dental tissues, alone or in combination. The colon is frequently a secondary focus of infection. Other areas act as focal infections in the production of chronic posterior uveitis but with much less frequency.

3. There is an intermediate allergic state in chronic posterior uveitis in which the patient is sensitive to uveal pigment.

4. Lenticular changes (cataracts) occur in a relatively high percentage of patients with chronic posterior uveitis.

5. The pigment-bearing portion of the internal ear probably shares in the allergic reaction to the pigment melanin.

TABLE NO. 1

Total number of patients with chronic posterior uveitis, 230.

Average age, 45 years; eldest patient, 68 years; youngest patient, 10 years.

Total number of males, 116; total number of females, 114.

Unilateral chronic posterior uveitis present in	78	or 33.90	per cent
Right eye	48	or 20.80	per cent
Left eye	101	or 43.90	per cent
Bilateral chronic posterior uveitis present in	149	or 64.00	per cent
Ethmoidal sinusitis present in	65	or 38.20	per cent
Maxillary sinusitis present in	14	or 6.09	per cent
Sphenoidal sinusitis present in	5	or 2.10	per cent
Frontal sinusitis present in	10	or 4.20	per cent
Paranasal sinus infection, total	94	or 40.80	per cent
Tonsillar infection present in	94	or 40.80	per cent
Tested with uveal pigment	29	or 12.60	per cent
Hypersensitiveness to uveal pigment present in	29	or 12.60	per cent
Dental infection present in	75	or 23.90	per cent
Wassermann (positive)	7	or 3.04	per cent
Hypersensitiveness to tuberculin present in	5	or 2.10	per cent

Occurrence of posterior uveitis by decades:

First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth
1	5	20	86	35	27	39	13	4
1-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90

TABLE NO. 2

ADDITIONAL COMPLICATIONS

Colitis	57 or 24.80%	Hypothyroidism	3 or 1.09%
Lenticular opacities (cataract)	55 or 22.80%	Retinal detachment	3 or 1.09%
Arterial hypertension	23 or 10.00%	Pulmonary tuberculosis (active)	2 or 0.80%
Deafness	28 or 12.16%	Episcleritis	2 or 0.80%
Kidney infection	7 or 3.04%	Arthritis multiple	2 or 0.80%
Prostatitis	7 or 3.04%	Middle ear infection (chronic)	2 or 0.80%
Allergic rhinitis	5 or 2.10%	Thrombosis central retinal vein	1 or 0.40%
Ophthalmic migraine	5 or 2.10%	Malaria	1 or 0.40%
Glaucoma (all types)	5 or 2.10%	Blue sclerotics	1 or 0.40%
Heterochromia iridis	5 or 2.10%	Drug allergy	1 or 0.40%
Diabetes	4 or 1.60%		
Retinal hemorrhage	4 or 1.60%		

Multiple complications were not infrequently encountered in the same patient.

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LV

NONTUMOROUS CYSTS OF THE MAXILLA: INTERESTING CASES AND DISCUSSION*

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We are reporting seven cases of maxillary cysts of dental origin. Six of these encroached upon the antrum. One was complicated by an osteoma, and, in one case, impacted teeth were present within the cyst. Supernumerary teeth were present in two others. Some of the cysts were of large size. Three were bilateral. In two cases the cyst became manifest after extraction of teeth, and two were associated with carious teeth. The other three were of follicular origin.

Cysts of dental origin, other than those resulting from adamantinomata, are usually designated as follicular or radicular cysts. The former, sometimes referred to as dentigerous cysts, are those which are associated with the second dentition. Their presence often can be suspected from defects in the dental arch due to unerupted or supernumerary teeth. They are symptomless, unless of large size or infected, and are most often discovered by x-ray examination. Dentigerous cysts are usually associated with an impacted or unerupted tooth. The crown of the incarcerated tooth is centripetally placed in the cyst, whilst the root is embedded in its bony wall. As a rule, in cases of a single tooth, the crown is well formed, but the root may be quite rudimentary. The literature is sprinkled with reported cases of follicular cysts, in which as many as several hundred rudimentary teeth have been found.

Radicular cysts are always found in connection with infection at the root of a devitalized tooth. They do not contain teeth.

Both types of cyst may be infected or noninfected and the contents may vary from fluid to semisolid amorphous material. Upon

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enlargement, either type may cause secondary devitalization of neighboring teeth.

A number of the most tenable theories of origin of radicular cyst have been discussed by Moorehead and Dewey,[1] who conclude that: "to sum up the possible origin of the epithelium-lined root cysts we may say remnants of Hartwig's epithelial root sheath or Malassez's peridental epithelial debris are probably the most frequent, but not the only source of derivation. Remains of the epithelial budding from various parts of the tooth gum and the gingiva, such as described by Malassez, must also be taken into consideration, and finally the proliferation of the adult oral epithelium may be the origin of the cyst epithelium in some cases."

Malassez's rests are persisting inclusions of epithelial cells found beneath the gingival epithelium, in relation to the peridental membrane and periosteum, the crown of the developing tooth and the gingival mucosa. It is generally considered that periapical infection is the exciting influence in the development of these cysts.

The usually accepted theory of the development of a follicular cyst is that it results from the hollowing out of the follicle of an unerupted tooth. In some instances, particularly in the lower third molar area, a follicular cyst apparently can arise from the retained follicle following the extraction of a partially impacted tooth. Both of these will be commented upon further.

PATHOLOGY

In regard to histogenesis of cysts of dental origin, there are many theories, each of which has ardent testimony in behalf of its validity. However, when critically scrutinized, none of them seem to conform to usually accepted pathological concepts.

Most of the various theories of origin state in common that the cyst lining is derived from gingival epithelial embryonic rests and that the exciting factor is irritation. In the case of a radicular cyst, the stimulating influence is said to be the proximity of periapical granulomata to epithelial rests, whilst in follicular cysts the continuous but thwarted attempts at eruption of a tooth is said to result in irritation of the follicular sac with subsequent cyst formation.

In regard to radicular cysts, these are unsatisfactory concepts because stratified squamous epithelium, with which the majority of nontumorous maxillary cysts of dental origin are lined, is nonsecretory. We can see no reason why gingival buds of epithelium should possess secretory function when morphologically they are similar to nonsecretory and noncystic epithelial remnants found under epithe-

lial surfaces in other parts of the body. It is also not clear as to what manner degeneration of the central cells of an epithelial remnant could provide sufficient fluid to constitute a cyst. When cyst fluid is withdrawn it is replaced rather quickly. The replacement obviously cannot be due to further degeneration of lining epithelium.

Radicular cysts are associated with devitalized teeth bearing periapical granulomata. Periapical granulomata are very common. Malassez's epithelial rests also have been established as a common finding. Therefore, if periapical granulomata were the sole cause of stimulation of development of radicular cysts, one would expect to find these cysts associated with them much more often than they are reported. Apparently there is some exciting factor other than the presence of a granuloma, which remains to be discovered. The contention that devitalized teeth, in the role of foreign bodies, stimulate cyst formation likewise is untenable, because other foreign bodies which are not uncommon, such as spicules of bone following tooth extraction, bits of filling materials, deep-laid scale in pyorrhea alveolaris and toothbrush bristles, are not found associated with so-called radicular cysts. If chronic irritation at the apex of a tooth is an exciting cause in radicular cysts, why do they not develop in cases of malocclusion where there is repeated torque strain at the apices?

In follicular cysts two theories of formation usually advanced are, first, that the cyst is the result of distention of the follicle about the crown of an impacted tooth. The second is that some form of irritation stimulates the development of a cyst from epithelial rests and that perversion of function of the lining epithelium is responsible for the development of a well-formed tooth or a number of denticles. The second theory is confronted by the same objections that were encountered in consideration of the development of radicular cysts from epithelial rests, and, therefore, is not clear. Although the first theory seems more reasonable the exact mechanism of cyst formation similarly is not clear. Constant prolonged pressure of an impacted tooth against an unyielding force would lead to atrophy of some of the surrounding follicle. If inflammation were present, and, such is not generally an accompaniment of atrophy, we could understand the beginning of dilatation of the follicle through osmotic interchange of fluids.

Nontumorous cysts of the maxillae may attain a considerable size. The nature of the increase in fluid is not understood. Certainly it is not a secretory product of the epithelial lining. It is possible that the increase in amount of fluid is the result of differences in osmotic pressure between the cyst content and the blood plasma and

lymph, an interchange analogous to that which occurs in the enlargement of subdural hematomata. In the latter a thin wall of granulations, with an abundance of large capillaries, acts as a semipermeable membrane permitting the passage of plasma into the hematoma which has a greater specific gravity. Another possibility is that when cyst fluid is infected the exudate of plasma which is a part of exudative inflammation may contribute to the fluid. It is probable that the cyst fluid is originally a transudate. We plan in future cases to attempt to learn something of the nature of the genesis of fluid through determining the interchange of phenosulphophthalin from the blood into the cyst fluid and vice versa. The specific gravity of the cyst fluid, introduction of inert particles such as india ink into the cyst and the prussian blue reaction should also be studied in an attempt to find out more about the origin of fluid. The disposition of Thorium dioxide solution introduced into the cyst could be estimated in part by x-ray and histologically after removal of the cyst wall.

The cysts under consideration are all originally situated in bone. As they enlarge they cause atrophy of bone characterized by halisteresis and osteoporosis. With continued growth the surrounding atrophic bone is distended until finally the cyst may be limited only by a thin cortical shell which may in time be perforated. In the wake of bone atrophy there may be some attempt at bone formation characterized by islands of osteoid matrix with some calcification. The "eggshell" fragments of bone found in the outer part of the cyst walls in some cases are of this character or remnants.

Very large cysts may perforate the outer cortical plate in the canine fossa to be limited by only the soft tissues. The floor of the orbit may be raised or the malar eminence hollowed. The anterior labial plate of the alveolar process may be bulged forward when it is invaded. Marked distention may permit the cyst to bulge the upper lip forward. The opposite maxilla may be encroached upon by a cyst extending through the anterior alveolar process, and changes similar to those on the side of original involvement be produced.

In some instances the cyst in distending the hard palate will cause perforation of its lower plate so that the cyst presents in the roof of the mouth as a boggy fluctuant mass. Erosion of the upper plate is responsible for elevation of the floor of the nose with upward and forward displacement of its base. Nasal obstruction may result from this and medial displacement of the lateral nasal wall. The latter occurs largely through encroachment of the maxillary sinus by the cyst. The cyst may compress and obliterate the sinus, but actual rupture into it is not reported.

While in the alveolar process advancement of a cyst may, through pressure, displace neighboring teeth. Encroachment upon the blood and nerve supply of neighboring teeth may cause their devitalization.

The lining of follicular or radicular cysts is a squamous epithelium which may be modified through pressure or infection. The subepithelial structure is composed of fibrous tissue, and if infection is present, granulation more centripetally. In our cases tissue spaces, lymphatics and blood vessels were abundant in the immediately subepithelial area. Leucocytic infiltrations and prismatic clefts of cholestrol deposits are common.

Ulceration of the lining is found in infected cysts.

The cyst fluid is sterile in most cases. The method of infection of the more deeply placed cyst is not clear. Infection may be followed by pointing, rupture, drainage and sinus formation.

All the above remarks, except those concerning histogenesis, apply equally well to radicular and follicular cysts. As far as morphology is concerned, the only difference is, as mentioned above, the presence of a tooth or denticles in the latter.

DIAGNOSIS AND TREATMENT

The diagnosis of nontumorous cysts of the maxilla should not be difficult. Slow growing tumor masses such as odontoma, cystic adamantinoma or deeply placed malignancies, such as carcinoma of the antrum, must be considered in the differential diagnosis of any swelling of the maxilla or overlying soft tissues. The absence of a tooth in the dental arch may lead one to suspect a follicular cyst. Palpation and aspiration of the mass gives valuable information. The former may, in the case of the cysts under discussion, yield a sensation of crepitus. Clear fluid containing cholesterol crystals is also significant. If there is erosion through the cortical place of the palatal bone, there may be some confusion in diagnosis between subperiosteal abscess of the palate and these cysts. Associated face and palate deformity are rather characteristic, for there is no accompanying cachectic symptoms and signs nor epistaxis, such as usually is present in malignancies of the antrum.

X-ray will aid in excluding cystic adamantinoma and in differentiating between these other conditions. Biopsy and x-ray examination should be done routinely even though the diagnosis is apparent.

Any possible confusion between an apical abscess and a small radicular cyst is avoided through x-ray examination, since in films the latter presents a sharply demarcated border.

Fig. 1. Case 1. *A*. Lateral view and bite film show an extensive cyst with atrophy of bone and considerable deformity. *B*. Lateral view of skull shows the cyst extending into the malar eminence, into the floor of the orbit and posteriorly in the palate to the third molar area.

The presence of a tooth or teeth in a cyst on x-ray examination establishes the diagnosis of follicular or dentigerous cyst. The association of a devitalized tooth with a cyst which does not contain a tooth or teeth points to the presence of a radicular cyst.

The treatment of these cysts should consist of removing the cyst by blunt dissection through an intra-oral incision made over the point of greatest swelling. The remaining cavity is then connected to the nose through a large sized window under the inferior turbinate. The first incision is sutured. The cavity is irrigated through the antronasal window. This type of treatment tends to result in less deformity and discomfort and more rapid healing than packing and irrigation through the intra-oral incision.

REPORTS OF CASES

CASE 1.—Radicular cyst. M. R., a colored male, age 29, entered the Buffalo City Hospital January 6, 1929, complaining of a painful tumor of the palate of one year's duration. Four years before he had a similar swelling of six months duration. He stated pus and blood escaped after incision by a physician. The present mass has been attended by swelling of the left cheek, later the right one, and nasal obstruction. Its growth has been attended by intermittent, dull, throbbing pain.

There was a nontender, large fluctuating mass bulging the hard palate towards the tongue. It was also palpable over the right canine fossa, the malar prominence and up to the lower border of the right orbit. The mass bulging the left maxilla was not quite as large and was nonfluctuant. The tip of the nose was elevated and the upper lip stretched and protuberant and somewhat tense. The anterior and middle portion of the floor of each side of the nose was moderately elevated. There was partial obstruction to either side of the nose, but more marked on the right.

Later data were not remarkable.

X-rays showed a cyst shadow with a thin calcified wall extending from a bulged lateral plate of the alveolar process posteriorly to the edge of the hard palate. Vertically it involved both malar eminences, and raised the floor of either orbit. The anterior part of the palate bone was destroyed and the roots of the anterior teeth were seen within the bony confines of the cyst. The anterior wall of the cyst was perforated at several points.

Fifteen days after admission, the alveolar ridge of the maxilla was incised above the roots of the teeth, the soft tissue retracted and a cyst the size of a tangerine encountered. The lining was removed by blunt dissection. The cyst cavity involved the entire anterior part of both maxillae, bridging through the anterior part of the hard palate and alveolar ridge, the labial plate of the latter being bulged anteriorly, and was of eggshell thickness. Both antral cavities were encroached upon by the cyst. On both sides the cyst extended into the malar portion of the maxilla and the floor of the orbit. The characteristics of the lining and the nature of its contents were not recorded. The bone was noted as being very thin. The cyst cavity was packed with vaselined gauze. A septic type of temperature was present for three days after operation.

Two portions of the cyst wall were received by the laboratory. These were two thin flat tissue structures measuring approximately 1½ cm. and 12 by 2½ cm., respectively. One surface was covered by brownish soft granulation. The other surface bore thin small plaques of bone resembling eggshell. The cut surface of the wall was fibrous in character.

Microscopically, the cyst was lined in places by a stratified epithelium varying from two to five cells in thickness. In some places there was no lining. At the site of such defects there was moderately mature granulation tissue diffusely infiltrated with lymphocytes, polymorphonuclear leucocytes and histiocytes laden with hemosiderin. A

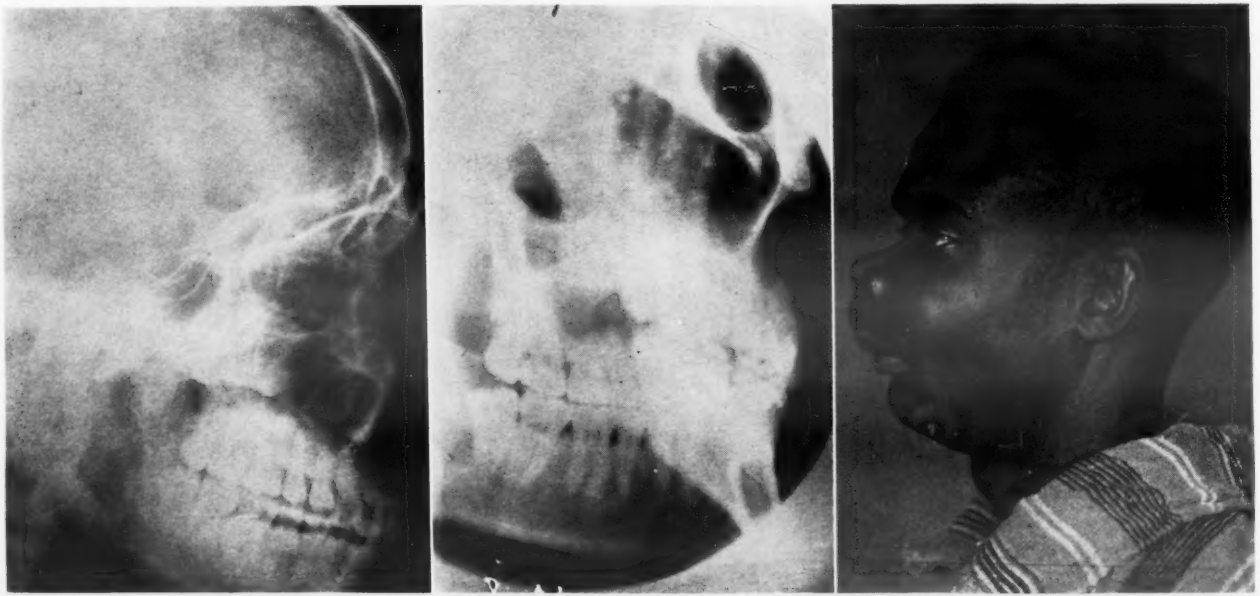

Fig. 2. Case 1. Note swelling over canine fossa which extends forward to elevate base of nose and push it and upper lip forward. The swelling extends to the inner canthus of the right eye.

more peripheral portion of the wall was composed of moderately dense collogen fibers, hyalinized in some places and in others exhibiting small areas of calcification. In the outer portion of the wall there were hemosiderin laden histiocytes in narrow tissue spaces which were not lined by endothelium.

Three and one-half months later there was still considerable drainage from the wound. The record after this date was not entirely clear, but it was evident that nine months after operation an upper denture was made to replace successfully the previously extracted teeth and reduce facial deformity.

CASE 2.—Radicular cyst. On October 10, 1935, a white male, F. P., age 53, was admitted to the Buffalo City Hospital complaining of pain and swelling in the area above the upper right lateral incisor, and inability to breathe through the right nostril. He gave a history of having had the upper right lateral incisor removed about six years ago. For about a week this was followed by drainage of pus through a pin-point sinus in this area.

There was an upper anterior bridge in place extending from cuspid to cuspid with a marked bulging over the right lateral incisor area. Palpation over this elicited a crackling sensation. The adjacent bony structures were soft and spongy. The thinned outer plate was pierced by an aspirating needle and about 10 cc. of clear straw-colored fluid withdrawn. This was accompanied by pain. Cholesterol crystals floated in the fluid. The fluid was sterile on culture. Immediately on withdrawal of the needle the patient stated he could breathe through the right nostril.

X-rays showed a cyst involving the maxillae and palate from bicuspid to bicuspid area and posteriorly almost to the soft palate.

On February 3, 1936, the upper left cuspid was removed and a large mucoperiosteal flap extending from the first bicuspid to first bicuspid elevated. The anterior plate of alveolar bone was reduced to tissue paper thinness. The cyst cavity seemed to be about the size of a hen's egg and its wall bulged the lateral wall of the left nose medially. Posteriorly it reached the soft palate and superiorly to the floor of the orbit. The lining was removed with moderate ease and the cavity packed with vaselined gauze. The following day the temperature was slightly elevated and there was some hemorrhage into the orbit.

Squamous epithelium varying from two to four cells in thickness lined the cyst. The cells were polygonal, edematous and some-

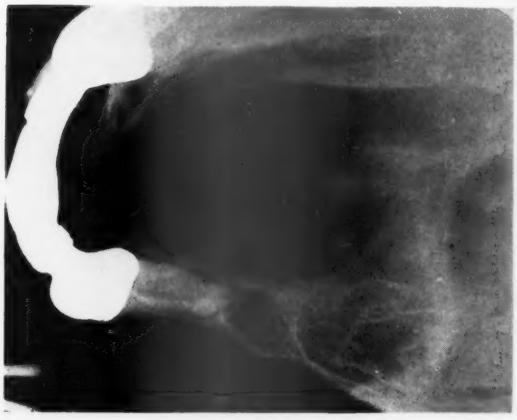

Fig. 3. Case 2. Photograph of bite film. A large cyst occupying most of the hard palate and extending posteriorly as far as the bicuspid area.

what loosely arranged. The basement membrane could not be discerned. The subjacent stroma was a loose pink-staining myxoid matrix with many tissue spaces which were not lined by endothelium. There was also a considerable number of lymph channels and small blood vessels. Lymphocytes and mononuclear leucocytes were scattered loosely throughout the stroma. There were plump spindle and star-shaped fibrocytes.

It was planned to replace the mucoperiosteal flap following the construction of a nasal window. These procedures were refused and the patient was discharged to the out-patient department, where the packs were regularly replaced until all activity in the lesion subsided.

About a year following this the patient returned for a completion of treatment. A nasal window was made and the mouth wound closed by means of a plastic flap from the palate. The patient at the present time has little deformity and no discomfort and is wearing a denture successfully.

CASE 3.—Radicular cyst. E. M., a while male, age 24, entered the Buffalo City Hospital complaining of a swelling in the left cheek, present for five years. The swelling was the size of a plum, soft, fluctuant and apparenty fixed to the soft and hard tissues of the prominence of the maxilla. It was neither painful nor tender. There was no history of discharge or variation in the size of the swell-

Fig. 4, Case 3. Photograph of the lateral x-ray. This shows the cyst occupying the area of the left autrum. The upper left second molar which projects into the cyst has a root canal filling.

Fig. 5. Case 3. The deformity is apparent. The swelling was also quite definite within the mouth.

ing. On intra-oral palpation no bony structure could be found over the canine fossa, as the cyst had destroyed its outer bony wall. X-rays showed a large cystic area in relation to the left bicuspid and first molar teeth. The root canal of the latter contained a filling. The cyst was well outlined in lateral views.

Ten cc. of straw-colored clear fluid was aspirated from the cyst. Cholesterol crystals floated in the fluid. Cultures were sterile.

Under local anaesthesia a Caldwell-Luc incision was made and a mucoperiosteal flap raised with some difficulty. At this time the cyst wall was perforated and about 7 cc. of clear straw-colored fluid escaped. The lining of the cyst was pink, finely nodular and about 3 mm. in thickness. This was removed with much difficulty, as its outer aspect had become adherent to the soft tissues of the cheek. The surrounding bony walls were entirely destroyed except for adherent thin parchment-like fragments. The ostium of the left maxillary sinus was visualized but the entire antrum proper was obliterated. The mucoperiosteal flap was replaced with sutures. It was deemed advisable not to remove the upper left devitalized molar at the time of operation because of the previous extensive loss of bone structure. Several days later a nasal window was placed under the inferior turbinate into the cyst cavity to provide adequate drainage for possible infection. All wounds healed promptly and uneventfully with a good functional and cosmetic result. Two months later the offending molar was removed with no untoward results.

CASE 4.—Radicular cyst. J. J., a white male, age 60, entered the Buffalo City Hospital September 22, 1936, complaining of a swelling over the right canine fossa for three months. This was not painful and was slowly growing. He stated that there was some difficulty in breathing through the right side of the nose. Three months prior to the appearance of the above mass a similar swelling had discharged pus into the mouth.

There was a fluctuant, nontender, noncrepitant, plum-sized mass in the canine fossa. It displaced the upper lip forward and the nose slightly upward and to the opposite side. Intra-oral palpation elicited a bulging, with a pronounced sense of fluctuation over the mucobuccal fold in the canine fossa area.

All the upper teeth had been extracted one year previously. The remaining lower teeth were vary carious. When first examined in the clinic the swelling was aspirated from within the mouth with the thought of preventing possible rupture through the skin of the

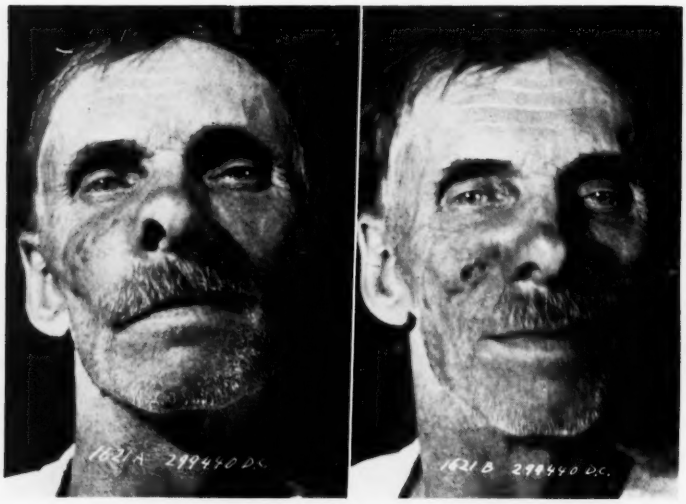

Fig. 6. Case 4.

Fig. 7. Case 4. *A.* Note swelling over canine fossa with deformity of cheek, nose and lip. *B.* After aspiration. The dark line is a shadow.

Fig. 8. Case 4. Photograph of x-ray bite film. Note the massive cystic involvement of the hard palate with atrophy, perforation and bulging of the anterior labial plate.

cheek. The fluid was brown, turbid, contained a few red blood cells, lymphocytes, polymorphonuclear leucocytes and was sterile. The swelling decreased in size following aspiration and he was again able to breathe through the right side of the nose. Six weeks later the swelling had returned to its original size. Other clinical findings were hypertension, pneumonoconiosis and infiltrative pulmonary tuberculosis.

At operation the aspirated fluid was of the same character as that previously examined. A transverse incision was made along the crest of the upper alveolar ridge, extending from the central incisor region to the molar area, and a mucoperiosteal flap elevated, whereupon the wall of the cyst was encountered. A few fragments of eggshell thickness of bone were adherent to its outer aspect. The cyst extended from the first molar area in the right side to a point well past the mid-line. The entire maxillary sinus was obliterated and its ostium was seen in the superior bony wall of the cyst after removing the membrane by blunt dissection. The inner aspect of the cyst was smooth, shining pink. Its wall was 1 mm. thick and very adherent to the surrounding bone structures. The cyst in definitely extending into the opposite maxilla expanded the anterior ridge of both maxillae. In so doing it also impinged on the lower part of the medial wall of the left antrum, causing atrophy and destruction of the bone therein, permitting visualization of the mucous membrane which moved to and fro with respirations.

The inner aspect of the cyst was covered in part by a stratified squamous epithelium which varied from one to eight cells in thickness. The cells were mostly flat. The basement membrane could not be seen. In the stroma where the epithelium was missing or very thin, there was considerable hemorrhage. There were many thin-walled, well-filled blood vessels in the fibrous stroma. Some of these were closely set under the epithelium. Loosely arranged small tissue spaces filled with gray staining material were a prominent feature. Some of these were found even in the epithelial layer. There were few lymphatics. Polymorphonuclear leucocytes and lymphocytes were scattered throughout, even congregating in the epithelium.

Because of the great size of the remaining defect, it was packed with vaselined gauze without attempting to close it at this time. The post-operative course was uneventful. When discharged three weeks later the cavity was dressed every second day. Healthy granulation had obliterated thirty per cent of the cyst cavity. The patient is still under observation and a plastic operation for the mouth defect is planned.

CASE 5.—Follicular cyst. R. Y., a colored male, age 34, entered the Buffalo City Hospital complaining of a swelling of the right cheek. This had been present for six years, at times temporarily increasing in size. Such enlargements were very painful and accompanied by fever. During several exacerbations (the last nine months ago) the swelling had been incised. On occasions pus had appeared at the mucobuccal fold at the left upper bicuspid area.

There was a swelling 5.2 x 4 x 2.5 cm. over the right maxillary area with partial closure of the right eye. This mass was tender, firm, nonfluctuant and not fixed to the skin. The latter bore two small scars. Crepitus could be elicited over the swelling. The mucosa of the hard palate was elevated from the right upper cuspid to the first molar area. There was some induration of the soft tissue posteriorly over the ramus of the mandible on the right. No teeth were missing nor were there any gross pathological changes.

X-ray showed a cyst in the right upper incisor region. This extended into the hard palate and seemed to be perforating the maxillary sinus. A dense mass, suggestive of new growth, almost filled the antrum. The maxillary sinus which was irregularly enlarged in all diameters was almost filled with a dense rounded mass (osteoma). There was a rudimentary supernumerary tooth within the cyst above the apices of the central incisors.

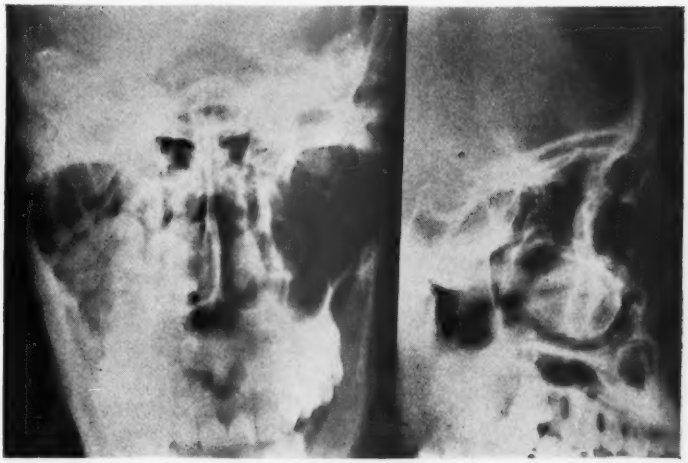

Fig. 9. Case 5. *A.* Anterior posterior view. Note deformity of the right antrum with enclosed mass of increased density. The cyst containing a tooth can be seen above the central incisor. *B.* The lateral view shows the same pathology with a thin, somewhat frayed bony wall separating the cyst cavity from the antrum.

The polymorphonuclear leucocytes numbered 11,200, with 54 segmented forms, 19 stabs and 27 lymphocytes. The temperature was 99.4° F. At operation the cystic area, 2.5 cm. in diameter, was entered through the labial plate of alveolar bone above the central incisors. The cyst lining was smooth, pink and varied from 1 to 2 mm. in thickness. The contained fluid was thick, grey and purulent. Smears of the fluid from the cyst contained many gram positive diplococci and gram negative and positive bacilli. There were also many polymorphonuclear leucocytes and scattered lymphocytes. A supernumerary tooth with a peg-shaped crown projected into the cyst from its wall. The rudimentary roots of this were embedded in the cyst wall between the central incisors. The tooth and cyst lining were removed. In so doing the antrum was entered. It was about 2 by 3 cm. in its greatest diameters and bore upon its superior and medial walls a hard, white, rounded bony mass (osteoma).

The lining epithelium was of the stratified squamous variety, having well-developed papillary pegs. The stroma was edematous, had many lymphatics, a few blood vessels, and was densely infiltrated with polymorphonuclear leucocytes and lymphocytes.

A nasal window into the maxillary sinus was fashioned under the inferior turbinate and the first incision closed after packing the cyst cavity with vaselined gauze. Healing was rapid with good functional and cosmetic results. Three weeks later the osteoma was examined through the nasal window with the nasopharyngoscope. Biopsy and operation were refused.

CASE 6.—Follicular cyst. A white male, P. P., age 29, was referred to the Buffalo City Hospital December 20, 1933, with complaints of pain and swelling over the left upper cuspid area, with drainage of pus therefrom. The referring dentist stated that the patient had an alveolar abscess.

X-rays revealed a follicular cyst around an impacted left upper bicuspid. The cyst extended over the central incisor region back to the second bicuspid area. The upper left lateral incisor was partially displaced from its original socket by pressure from an impacted tooth. There was also an impacted right cuspid which had attained full growth. Both lower deciduous cuspids were still in place. On lateral view the cyst appeared to be only about 2 cm. in vertical dimension. At operation it proved to be much larger.

Because of elevated temperature and the presence of acute infection, on the day of admission the offending incisor was removed without disturbing the cyst.

Eighteen days later, when the acute infection had subsided, the cuspid tooth and the lining membrane of the cyst were removed. The lining was thickened and studded with polypoid projections. During the operation it was noticed that the entire antrum was obliterated. However, the ostium was easily seen after the cyst lining was removed. A visiting staff surgeon, departing from our usual procedure, placed a large gauze pack in the cyst cavity to encourage drainage through the palate, and ordered it replaced daily after washing the cyst cavity under pressure. Twenty-six days later a nasal window was placed into the left maxillary sinus area. During the course of the patient's hospital stay the cyst cavity remained open. This we attribute to the nonclosure and packing of the palate incision and the subsequent fibrosis of the wound margin.

Microscopically the inner aspect of the cyst was composed of stratified squamous epithelium fifteen to twenty cells in thickness. In some areas this bore a thin keratohyaline layer. The papillary pegs were short. The subjacent stroma was composed of collagen fibrous tissue. In this there were a few blood vessels with fibrously thickened

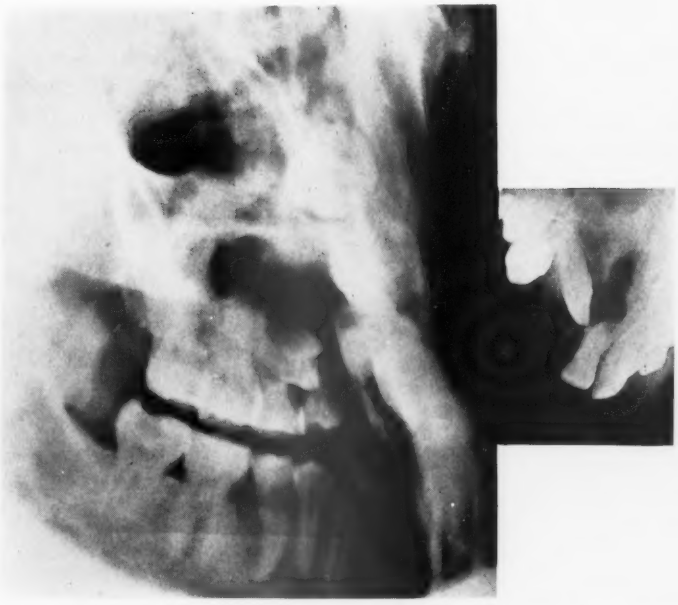

Fig. 10. Case 6. Photograph of lateral and bite film x-rays. The cyst is seen in the anterior part of the hard palate with a bicuspid crown in the cyst cavity. In the bite film there is an impacted cuspid on the opposite side extending into the cyst.

walls. There were a number of tissue spaces which were not lined by endothelium. Closely set around these were plump spindliform and triangular cells with scant cytoplasm and deeply staining large nuclei. These were embedded in pink staining amorphous island strips. Nearby, definitely in relation to the spaces, were giant cells which we interpreted as osteoclasts. A well-formed spicule of bone, in relation to which there were two osteoclasts, was surrounded by a clear space. There were also some empty, well-formed lymphatics.

Other sections of deeper parts of the cyst wall presented only bone structure. This had the typical reaction of bone resorption, viz., halisteresis, and wide, thin-walled vessels, large spaces and proliferation of fibrous connective tissue between bony septa.

On February 13, 1934, all the upper right teeth were removed. These included the impacted cuspid, second bicuspid, and the decidu-

ous cuspid. The second molar and the impacted third molar were also removed from the left side. A considerable portion of the palate bone was excised and the large opening on the left side which exposed the cyst cavity in the antrum area was closed by moving the remaining palate to the left. Healing was uneventful. On March 2, 1934, the patient was discharged from the hospital to the out-patient dental clinic, where, three months following the last operation, an artificial denture was placed in the upper jaw. The patient has worn this successfully. There is slight residual deformity of the palate, which does not interfere with function. The left flange of the denture had to be built out to compensate for facial deformity.

CASE 7.—Follicular cyst. B. B., a colored male, 42 years, was admitted to the Buffalo City Hospital March 2, 1937, complaining of drainage of purulent material from the anterior part of the hard palate.

It was learned that about six weeks previously a tender swelling appeared in the region of the right upper first molar tooth. One week later a second fluctuant red mass was incised above the site of the right lateral incisor with drainage of thin purulent fluid. The soreness persisted and two weeks prior to admission to the hospital a dentist incised the mass again. The swelling and soreness subsided following this, but drainage of the fluid persisted. Temperature, pulse and respiration were normal. The blood Wassermann reaction was four plus.

X-rays showed a cystic shadow with a thin calcified wall extending from the right incisors posteriorly into the hard palate. There was a supernumerary peg-shaped tooth with practically no root formation in the anterior part of the cyst. No lateral films were made.

Two days after admission a follicular cyst was removed from the anterior part of the right maxilla. The cyst was 3 cm. in diameter and extended posteriorly into the maxilla, not reaching into the antrum. Its lining was smooth, pink and the cyst wall was about 3 mm. in thickness. The fluid was gray, thick and purulent. There was a supernumerary tooth lying beneath the roots of the central incisors, embedded in the wall of the cyst with its crown protruding into the lumen. The crown was fairly well formed, much after the fashion of a central incisor. The root was straight but stunted. The entire tooth was less than 1 cm. in length. The bone, after removal of the cyst, was smooth, hard and glistening white with no perforations. Healing was uneventful.

Fig. 11. Case 7. Photograph of bite film x-ray. A cyst containing a supernumerary tooth occupys the anterior part of the hard palate.

Microscopically the lining was composed of stratified squamous epithelium varying from two to five cells in thickness. In some situations the epithelium was defective. Elsewhere it was edematous and interrupted by granulation tissue, the predominant element of which was capillaries. There was an infiltration of lymphocytes and a few mononuclear leucocytes beneath the epithelium. A mature collagen fibrous wall was peripheral to this inflammatory zone.

DISCUSSION OF CASES

Of the above seven cases six patients had perforation of the outer cortical plate of the maxilla with a resultant facial deformity. In three of these the cyst wall was densely adherent to the soft tissues of the cheek. In the same six individuals the cyst encroached upon the antrum. Three of these were more advanced with bilateral antral involvement. Another patient (case seven) had a small follicular cyst in the anterior part of the maxilla with no symptom other than pain, and no sign, other than bulging of the palate. The diagnosis in this case was made solely by x-ray, since no devitalized teeth were in the area and no teeth were missing from the dental arch.

The advanced case of follicular cyst associated with an antral odontoma (case 5) presented an interesting study because we were confronted with the same difficulty as in the one mentioned just above, the swelling being posterior to the cyst, and no devitalized teeth being present in the dental arch and no teeth were missing. The cyst was suspected because of slight bulging of the labial plate over the anterior teeth. Most of the swelling presented posterior to the canine fossa and its cause was identified only by a series of x-rays. The cyst in this case was only of moderate size, but due to pressure from the enlarging antrum, which met the cyst, the bony partition was perforated. The antrum was about twice the normal size and almost filled with an osteoma.

In case six the perforation of the hard palate was a rather uncommon cystic lesion, inasmuch as the cyst extended through the dense lower palatal plate rather than into the less resistant alveolar ridge and the relatively thin labial plate. There was a poor cosmetic result in this case, probably because of the prolonged packing with nonclosure of the palatal incision. It would have been more satisfactory to suture the palatal incision at the time of operation and secure drainage through an antronasal window.

Two others of our cases were packed orally and closed at a later date after the cyst had become smaller and an antronasal window made. The remaining cysts were closed immediately at time of operation. In one of these an antronasal window was made the following day; another was the case complicated by the odontoma, and the third was the small cyst which did not involve the antrum.

The cases in which immediate closure was done showed the best cosmetic results, with the least amount of discomfort to the patients. They also healed more rapidly.

SUMMARY

The pathology, clinical aspects, treatment and etiology of nontumorous cysts of the maxilla have been considered. It has been pointed out that current theories which have come down through the years are inadequate to explain the origin of these structures. Seven cases have been discussed.

BUFFALO CITY HOSPITAL

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LVI

CEREBELLAR HERNIATION AS A CAUSE OF DEATH*

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Rochester, N. Y.

Within the last year seven patients have died at the Rochester General Hospital from respiratory failure associated with an increase in intracranial pressure and a herniation of the cerebellum into the foramen magnum.

In any of these cases a fatality might have been inevitable, but the fact remains that some time preceding death a lumbar puncture was performed, following which all showed signs of respiratory failure from which they did not recover.

An academic indictment, therefore, is made against these lumbar punctures as accessory or contributory causes of death.

It is not the purpose of this paper to express a personal opinion but rather to present the evidence for your consideration.

The following points sustain the accusation:

1. Death from respiratory failure became imminent after the lumbar punctures were performed. Case 4 died within five minutes, cases 5 and 6 within 15 minutes and 35 minutes, respectively, case 3 within one hour and 25 minutes, and cases 1, 2 and 7 showed immediate respiratory embarrassment.
2. All of these patients eventually died of respiratory failure.
3. Lumbar punctures in the presence of increased intracranial pressure can produce a cerebellar herniation into the foramen magnum with a secondary medullary compression and respiratory failure.
4. Such a herniation and medullary compression was actually demonstrated at autopsy in all of these cases.

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*Presented before the meeting of the Eastern Section of the American Laryngological, Rhinological and Otological Society, Boston, Mass., January 7, 1937.

The following points refute the accusation:

1. Sufficient intracranial pressure was present in all these cases to produce a cerebellar herniation with medullary compression and repiratory death, even if no lumbar puncture were performed.

2. Death from intracranial pressure does not necessarily result from direct medullary compression. It may result from compression of the veins draining the respiratory and other vital centers or from pressure effects in the hypothalamic region.

3. Cerebellar herniation with medullary compression is occasionally found at autopsy when no lumbar puncture has been performed.

4. There is reason for believing that in certain of these cases the lumbar puncture had no material effect. Cases 1, 2 and 7 illustrate the point. It is difficult to believe that a lumbar puncture death can occur six to twenty-three hours after a spinal tap.

A realization of the importance of sustaining or refuting this accusation has enabled us to present certain expert witnesses, to whom we acknowledge our gratitude and whom we shall question and quote.

Expert Witnesses

Dr. Alfred W. Adson	Rochester, Minn.
Dr. James B. Ayer	Boston, Mass.
Dr. Percival Bailey	Chicago, Ill.
Dr. Carl D. Camp	Ann Arbor, Mich.
Dr. Harvey Cushing	New Haven, Conn.
Dr. Walter E. Dandy	Baltimore, Md.
Dr. Leo M. Davidoff	New York, N. Y.
Dr. Wells P. Eagleton	Newark, N. J.
Dr. Charles A. Elsberg	New York, N. Y.
Dr. Temple Fay	Philadelphia, Pa.
Dr. Frank Fremont-Smith	New York, N. Y.
Dr. Gilbert Horrax	Boston, Mass.
Dr. George Lavine	Rochester, N. Y.
Dr. Wilder Penfield	Montreal, Canada
Dr. Tracy J. Putnam	Boston, Mass.
Dr. Ernest Sachs	St. Louis, Mo.
Dr. Ward Williams	Rochester, N. Y.

THE QUESTIONS

1. In case of death from intracranial pressure what, in your opinion, is the cause of death?

2. Can death be produced by pressure on parts of the brain not containing vital centers (that is, if the vital centers are not secondarily affected by the pressure)?

3. Do you believe a herniation of the cerebellum and medulla into the foramen magnum sufficient cause for death?

4. What other explanations are there for death from intracranial pressure?

5. In cases of increased intracranial pressure, can decreasing the intraspinal pressure produce or exaggerate a cerebellar herniation and thereby cause death?

6. If this can occur, does the length of time between the lumbar puncture and death vary according to the amount of herniation produced and the pressure involved?

7. Do you consider a well-controlled lumbar puncture safe or dangerous in the following:

(a) Supratentorial pressure.

(b) Subtentorial pressure.

(c) Intracranial pressure, with the localization unknown.

THE ANSWERS

QUESTION NO. 1

In case of death from intracranial pressure, what, in your opinion, is the cause of death?

Dr. Horrax	Medullary compression
Dr. Lavine	Medullary compression
Dr. Elsberg	Medullary compression
Dr. Dandy	Injury to medulla
Dr. Fremont-Smith	Compression of medullary veins
Dr. Fay	Anemia to the vital centers: (a) Respiratory (b) Vasomotor

QUESTION NO. 2

Can death be produced by pressure on parts of the brain not containing vital centers (that is, if the vital centers are not secondarily affected by the pressure)?

Dr. Adson	No
Dr. Bailey	No
Dr. Camp	No
Dr. Davidoff	No
Dr. Fay	No
Dr. Horrax	No
Dr. Penfield	No
Dr. Sachs	No
Dr. Ayer	Probably not
Dr. Dandy	*The centers are contiguous
Dr. Lavine	*Pressure is transferred equally to the vital centers
Dr. Williams	*Yes, if chronic so that vital centers are finally involved

QUESTION NO. 3

Do you believe a herniation of the cerebellum and medulla into the foramen magnum sufficient cause for death?

Dr. Adson	Yes
Dr. Ayer	Yes
Dr. Bailey	Yes
Dr. Dandy	Yes
Dr. Davidoff	Yes
Dr. Eagleton	Yes
Dr. Elsberg	Yes
Dr. Fay	Yes
Dr. Fremont-Smith	Yes
Dr. Horrax	Yes
Dr. Lavine	Yes
Dr. Penfield	Yes
Dr. Sachs	Yes
Dr. Williams	Yes
Dr. Camp	*Infrequently
Dr. Putnam	*Rarely

QUESTION NO. 4

What other explanations are there for death from intracranial pressure?

Dr. Adson	Circulatory and pressure effects in hypothalamic region
Dr. Ayer	Anemia and ischemia
Dr. Davidoff	The pressure involves the vital centers and produces anemia
Dr. Eagleton	Any localized disturbance of the relationship of the vessels
Dr. Fay	Circulatory failure—anemia of vital centers
Dr. Putnam	Circulatory

QUESTION NO. 5

In cases of increased intracranial pressure, can decreasing the intraspinal pressure produce or exaggerate a cerebellar herniation and thereby cause death?

Dr. Adson	Yes
Dr. Ayer	Yes
Dr. Bailey	Yes
Dr. Camp	Yes
Dr. Cushing	Yes
Dr. Dandy	Yes
Dr. Davidoff	Yes
Dr. Eagleton	Yes
Dr. Elsberg	Yes
Dr. Fay	Yes
Dr. Fremont-Smith	Yes
Dr. Horrax	Yes
Dr. Lavine	Yes
Dr. Penfield	Yes
Dr. Sachs	Yes
Dr. Williams	Yes
Dr. Putnam	Rarely

QUESTION NO. 6

If this can occur (Question No. 5), does the length of time between the lumbar puncture and death vary according to the amount of herniation and the pressure involved?

Dr. Adson	Yes
Dr. Bailey	Yes
Dr. Davidoff	Yes
Dr. Lavine	Yes
Dr. Putnam	Yes
Dr. Sachs	Yes
Dr. Ayer	Yes. Leakage is a factor
Dr. Dandy	Yes. In proportion to the degree of pressure in posterior fossa
Dr. Eagleton	Yes. Deaths are not immediate but the condition of the patient is immediately worse
Dr. Elsberg	Yes. Depends on amount of fluid removed
Dr. Fay	Yes. Depends upon— (a) validity of circulation; (b) degree of swelling already present; (c) type of case
Dr. Horrax	Yes. The time varies greatly
Dr. Williams	Yes. Death may be immediate or in a few hours
Dr. Fremont-Smith	*No relationship has been demonstrated

QUESTION NO. 7

Do you consider a well controlled lumbar puncture safe or dangerous in the following:

	Supratentorial Pressure	Subtentorial Pressure	Pressure, Localization Unknown
Dr. Adson	*Not always dangerous	Nearly always dangerous	Nearly always dangerous
Dr. Ayer	Hazardous	Especially hazardous	Hazardous
Dr. Bailey	Potentially dangerous	Most dangerous	Potentially dangerous
Dr. Camp	*More or less dangerous (But sometimes the risk is worth while)	*More or less dangerous	*More or less dangerous
Dr. Cushing	Dangerous	Dangerous	Dangerous
Dr. Dandy	*Fairly safe but useless	Very dangerous	Dangerous
Dr. Davidoff	*Safe with reservation	*Unsafe but sometimes necessary	*Safe with reservations
Dr. Eagleton	Dangerous if localized	Always dangerous	
Dr. Elsberg	*Well-controlled puncture is safe	Dangerous	
Dr. Fremont Smith	*Cannot be answered categorically		
Dr. Fay	*Not dangerous in frontal, parietal and occipital lesions; dangerous in midbrain and temporal lobe lesions	Dangerous	*Risk high but often justified
Dr. Horrax	Potentially dangerous	Most dangerous	Potentially dangerous
Dr. Lavine	Dangerous	Dangerous	Dangerous
Dr. Penfield	*Dangerous but sometimes justified	Most dangerous	*Dangerous but sometimes justified
Dr. Putnam	*Safe in patients without choked discs		
Dr. Sachs	Dangerous	Most dangerous	Dangerous
Dr. Williams	*Fairly safe, but not with choked discs	Dangerous	*In low pressure cases, safe

SIGNIFICANT OPINIONS

Dr. Davidoff: I believe that in the hands of people who are aware of the dangers, a lumbar puncture may occasionally be permissible in cases with high intracranial pressure.

Dr. Cushing: It has long been emphasized by neuro-surgeons that lumbar puncture was a particularly dangerous procedure in cases of elevated intracranial tension.

No.	Name	Sex Age	History	Clinical Diag.	Path. Diagnosis	Cerebrospinal pressure H_2O	Amt. withdrawn	Time between L. P. and death	Type of death	Apparent cause of death at autopsy
1	L. L.	13 M	Indefinite ear symptoms. Dullness	Brain abscess. Mastoiditis	Cerebellar abscess (walnut size)	Increase in pressure	1-2 cc.	6 hr. 5 min. Artificial resp.	Respiratory	Cerebellar herniation (marked)
2	V. N.	14 F	Discharging ear, 1 yr. Headaches, two wks.	Brain abscess. Mastoiditis	Temporal lobe abscess (lemon size)	440 1st day 450-190 2nd day	20 cc. 10 cc.	23 hr. after second tap	Respiratory	Cerebellar herniation (marked)
3	C. R.	38 M	Frontal headaches. Worked until day of death	Brain tumor	Temporal lobe tumor (lemon size)	Increase in pressure	2 cc. (?)	1 hr. 25 min.	Respiratory	Cerebellar herniation (marked)
4	L. F.	50 M	Headaches, 2 wks. No other complaints except slight confusion	Not diagnosed	Temporal lobe tumor (lemon size, cystic)	Increase in pressure	10-15 cc.	5 min.	Respiratory	Cerebellar herniation (moderate)
5	R. J.	43 F	Hypertension 10 yrs. Admitted in coma	Intracranial hemorrhage	Hemorrhage into basal ganglia and lateral ventricle	450 mm.	15 cc.	15 min.	Respiratory	Cerebellar herniation (marked)
6	A. R.	43 F	Hypertension 2 yrs. Admitted in coma	Intracranial hemorrhage	Subarachnoid hemorrhage into pons and medulla	350 mm.	10 cc.	35 min.	Respiratory	Cerebellar herniation (moderate)
7	M. M.	66 F	Complete left paralysis. Admitted in coma	Intracranial hemorrhage	Hemorrhage into left int. capsule (fist size)	320 mm.	12 cc.	6 hr.	Respiratory	Cerebellar herniation (?)

Dr. Putnam: I notice that in the autopsy room the appearance usually described as foraminal herniation is rather frequent in routine autopsies but little attention is paid to such cases unless there is reason to suspect that intracranial pressure is increased.

Dr. Penfield: At times I have seen some evidence of compression of the vertebral artery. Lumbar puncture may precipitate a fatal anemia of the bulb.

Dr. Fremont-Smith: I believe herniation of the cerebellum and medulla into the foramen magnum is a gradual process leading to increasing compression of the veins draining the respiratory and other vital centers in the medulla.

I believe lumbar puncture carefully performed almost never leads to difficulties in the absence of choked discs.

Dr. Horrax: In general, the greater the pressure, the greater the danger.

Dr. Ayer: I feel that the size of the hole made in the dura is of greatest importance and therefore the size of the needle employed and also the speed of removal.

Dr. Adson: We rarely advise spinal puncture in the presence of a brain tumor unless we are prepared to carry out craniotomy.

Dr. Dandy: For many years I have stressed the dangers of lumbar punctures in intracranial pressure. So dangerous is it that never is a lumbar puncture performed on one of my patients when intracranial pressure is suspected.

Dr. Sachs: I have been preaching for the last twenty-five years that it is dangerous to do a lumbar puncture in cases of increase or suspected increase of intracranial pressure. Deaths in these cases do not necessarily occur spontaneously. I have been trying to convince the otologists for many years that lumbar puncture is a dangerous procedure and I am glad to know that at last an otologist has taken up this question.

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LVII

PICRIC ACID-CALCIUM CARBONATE TREATMENT (STEWART) OF OSTEOMYELITIS APPLIED TO EAR AND NOSE CONDITIONS*

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The literature gives abundant evidence of the efficacy of live maggots, and maggot active principle in combination, for the treatment of chronic osteomyelitis. Probably the latest report is of the work done by Livingston[1] in a comparative series of 1,020 cases. He treated 415 cases with living maggots, and 605 cases with the maggot extract alone. The living maggots were used only in large copiously discharging suppurative wounds due to the difficulty of introducing a fluid into such a wound. After exudate decreased, the maggot active principle was substituted for the living maggots, used either as a drip or as a wet pack. Following debridement, or a radical sequestrectomy, the wounds quickly filled with pink healthy granulation tissue from the depths of the medullary cavity, completely filling the cavities to the level of the skin. Epithelization completed the process without a depressed scar. In Livingston's cases healing took place in six to twenty weeks. There is wider applicability of the extract, than of the living maggots, and the psychic trauma occasioned by the use of living maggots is eliminated.

In an effort to discover the cause of the phagocytic action of living maggots, Stewart[2] found that maggots exude calcium carbonate through their body walls. That drew attention to the finding of Bechold that calcium ions stimulate phagocytosis. Since bacteria excrete leucocidin, which destroys phagocytes, Stewart reasoned, from the hypothesis that leucocidin, or exotoxin, is protein in nature, that a dilute aqueous solution of picric acid would render the leucocidin insoluble, or inert, thus preventing its action upon the phagocytes. Surface tension, however, would prevent the acid reaching all parts of the wound. That was overcome by adding glycerin sufficient to make an eight per cent glycerin content in a 0.25 per cent aqueous

*From the U. S. Veterans' Administration Facility, Newington, Connecticut. Published with the permission of the medical director of the Veterans' Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the writer.

solution of picric acid in distilled water. The calcium carbonate suspension was made by adding 20 grams of this salt to 215 cubic centimeters of distilled water, and the suspension autoclaved.

Experiments with the picric acid solution, used alone, showed that progress of healing on experimental animals was not marked. The autoclaved aqueous suspension of calcium carbonate, used alone, resulted in considerable progress, but superficial. This indicated that the leucocidin, or exotoxin, in the wound overcame the phagocytes. Stewart then applied the picric acid solution, and followed it by the calcium carbonate suspension. Progress was marked, and rapid.

By use of the Baer treatment, the maggots apparently ingest the leucocidin, destroying it. The maggot active principle, no doubt, destroys the leucocidin at the same time stimulating phagocytosis. The picric acid solution renders the leucocidin inert. The calcium carbonate, from the maggots, stimulates phagocytosis. The calcium carbonate suspension accomplishes the same thing. Both actions, however, are necessary at the same time to accomplish results, as shown by Stewart's work. Livingston also found that the maggot extract is a more powerful growth stimulant than any one of its ingredients, which were used alone as a control.

Kline[3] reported four cases of osteomyelitis treated by the picric acid-calcium carbonate method of Stewart. His report was preliminary, as at the time he had fourteen cases under treatment. Since that time, he tells me, he has had many more, and results have been equally good. Further report from him may be expected.

A chemical method is, therefore, available to render inert the leucocidin and promote phagocytosis. It may be used in locations, where from a hygienic, aesthetic or psychic standpoint the living maggots and extract would be undesirable.

Chronic infections of the nasal accessory sinuses, wherein there is often an associated osteomyelitis (caries or necrosis) in varying degrees, may be considered analagous to chronic osteomyelitis as found in the general practice of surgery. We have a chronic abscess in rigid tissue, an abscess in rigid tissue which will not expand nor permit efforts on the part of the tissues sufficient for healing. Irrigations of various solutions, for their antiseptic and healing effects, have been unsuccessful in the treatment of chronic infected sinuses, particularly the maxillary sinuses. The maggot treatment cannot be used, and the extract, if known to the patient, would be objected to if not considered undesirable by the physician.

The Stewart treatment offers a very desirable method of treatment where preliminary operative work, as a debridement and proper drainage established, has been done.

Authorities are agreed, that following radical maxillary sinusotomies, discharge is present for a period of two months to two years. That in some cases for several years, and in some exceptional cases, there has been discharge for the balance of the life of the patient. This also holds true in chronic infections of the other sinuses.

Since there is a precipitate formed between the picric acid-calcium carbonate of a fine nature, sufficiently large openings must be made to allow use of the Stewart method of treatment in selected cases of chronic ear and nose (accessory sinuses) conditions.

The picric acid solution is easily sprayed into the opened sinuses by use of an atomizer equipped with the long, slender, detachable spray tip (that may be sterilized). The tip can be easily curved to insert through the opening, especially through a naso-antral opening, into the maxillary sinus. The calcium carbonate suspension is applied in the same manner.

It must be borne in mind, however, that the surroundings must be kept as aseptic as possible during treatment.

Contrary to the effect of most solutions used in irrigating the sinuses and medicines used for application, the picric acid-calcium carbonate alleviates existing pain. It is very well tolerated by the patient from a psychic as well as physical standpoint.

Case reports, in synopsis, are submitted that demonstrate basis of the foregoing:

REPORT OF CASES

CASE 1.—Adult, white, male. History: Sinusitis of the right maxillary sinus since 1928, with acute exacerbation at time of examination. The condition was treated for two weeks when a Caldwell-Luc operation was performed. At operation the sinus was found full of purulent discharge, the mucosa very thick with marked polypoid degeneration. The sinus was curetted, leaving the bone clean. Healing progressed satisfactorily and sutures were removed five days after operation, although at that time there was considerable discharge from the sinus into the nose. Three days later the discharge had increased, had become very foul, and the incision in the canine fossa had opened spontaneously. Treatment, with irrigations, was instituted with but moderate reduction in the amount of discharge, which continued foul. Nine days after irrigations were started, change was made to the picric acid-calcium carbonate treatment.

The incision began to heal rapidly, quantity and degree of odor of the discharge became less, incision was healed and all discharge disappeared and the patient was discharged one week later. Only seven daily treatments with the picric acid-calcium carbonate were given. During the period of discharge there was considerable pain, which became immediately relieved after the treatment with picric acid-calcium carbonate was instituted.

CASE 2.—Adult, white male. History of anosmia and loss of taste over a period of ten or twelve years. At time of examination the following were found: Chronic, severe, maxillary sinusitis, bilateral; nasal polypi, bilateral; obstructive deviated nasal septum; chronic hypertrophied infected tonsils, and anosmia and loss of taste. The tonsils were enucleated, submucous resection of the nasal septum performed. Healing and recovery were uneventful and rapid. A Caldwell-Luc operation was then performed on the right maxillary sinus and the nasal polypi on that side were removed. The sinus was full of polypi and purulent discharge. Healing and disappearance of discharge were rapid and uneventful. Three weeks later the left maxillary sinus was operated upon in like manner and nasal polypi were removed. At the time of operation a subperiosteal abscess was opened into on the lateral wall of the sinus and there was erosion of the bone. The entire contents of the sinus were thoroughly removed by curettage, leaving the bone clean. Healing appeared to be progressing in a normal, uneventful and rapid manner. The sutures were removed from the canine fossa on the fifth day following operation. Two days later the patient started sneezing, and showed all the external signs of an acute rhinitis. The incision opened spontaneously and a large amount of thick, foul purulent discharge was found in the left maxillary sinus. Irrigations were used for four days when the picric acid-calcium carbonate treatment was instituted. The treatment was given once daily. Rapid improvement and healing resulted. At the end of seventeen days the incision was well healed and the sinus was free of all discharge. During the acute stage the patient had excessive pain, but upon starting the Stewart treatment the pain subsided. Examination was made of the interior of the sinus by means of the nasopharyngoscope, and it was found covered with thin, healthy smooth granulation tissue throughout. The patient was discharged three days later free of all discharge, and his ability to smell and taste had returned to practically normal. He was re-examined two weeks later, when he returned by invitation to allow check-up, and he was found still free of all discharge and pain.

CASE 3.—Adult, white male. Hemiplegic, severe arteriosclerosis with severe hypertension. Examined August 11, 1936, and the

following condition revealed: Fistula leading from right maxillary sinus through gum into mouth, which was residual of tooth extraction for relief of pain thought to be due to an abscessed tooth. The sinus was irrigated and a large amount of foul purulent material was obtained. There was a large polyp growing from the fistula into the mouth, and the patient had a marked stomatitis. Due to the physical condition of the patient, radical sinusotomy was considered contraindicated. Under local anesthesia, the fistula was made larger by excising the surrounding tissue, and curetting the old tooth socket, which was much necrosed. A long Faulkner sinus curet was inserted into the sinus, and some polypoid tissue, and a large amount of thick purulent discharge removed. The sinus was irrigated beginning August 13th, and the picric acid-calcium carbonate treatment instituted. One daily treatment was given, and on September 22, 1936, there remained but a small fistula, no discharge, all pain absent, and inspection within the sinus with the nasopharyngoscope revealed a healthy appearing mucosa. As the patient wore an upper denture, it was considered best to leave the fistula patent, as the natural opening into the nose was very small and insufficient for good drainage in event of future infection. To date the sinus has remained well from information obtained.

CASE 4.—Adult, white male. This patient is one reported by the writer in 1935. "Streptococcic Meningitis, report of case with recovery."[4] The patient resides in another state. He was examined October 23, 1936, giving the following history: Following a severe head cold about three months ago, a slight swelling appeared behind the left ear in the old mastoidectomy scar. A physician incised it and put in a gauze drain keeping it open. At the time of the head cold, the ear had begun to discharge again and the patient had a headache. Later the muscles of the neck on the left became stiff and sore, drawing the head laterally and forward. The patient became worried with the thought that perhaps he was again getting the streptococcic meningitis, therefore he thought it best to return for examination and treatment.

Examination on October 23, 1936, revealed a torticollis. The left tympanic membrane had a central perforation from which there was a moderate purulent discharge, nonpulsating, which, on culture, revealed staphylococcus albus. There was a small fistulous tract leading through the postoperative mastoidectomy scar, and a probe was easily inserted into the mastoid antrum there connecting with the middle ear. The same organism was secured from the fistulous tract. There was no pain referable to the mastoid or the ear, and x-ray failed to reveal any destructive changes. The picric acid-calcium

carbonate treatment was instituted in the fistula and both solution and suspension came out through the perforation in the tympanic membrane washing out discharge ahead. Treatment was continued daily from October 23rd to December 22nd, after gently curetting the fistulous tract of all epithelium to within approximately the mastoid antrum under local anesthetic. On the latter date the fistula had filled in with healthy granulation tissue, and epithelium had grown over, giving the same appearance as when healed from the mastoidectomy. There was no discharge present in the middle ear, and smear and culture failed to reveal any. This case was cured without radical mastoidectomy, which he expected on recommendation of his own physician. He was not in any way disabled and the treatment was painless.

SUMMARY

Attention has been drawn to the efficacy of the picric acid-calcium carbonate treatment of Stewart for osteomyelitis.

From the few cases reported, it is considered that the results equal those obtained by the living maggot or maggot extract.

That due to psychic trauma, and objections to the use of the living maggots, or maggot extract, the picric acid-calcium carbonate treatment is applicable in locations and with patients where the other methods are not applicable.

With the Stewart treatment, granulation tissue forms promptly, purulent discharge is rapidly reduced, healing is rapid, pain and discomfort are minimized, and the residual scar is less marked than with any other, excepting the maggot treatment. It also produces rapid healing in chronic flesh wounds in addition to chronic bone conditions.

The Stewart treatment is most satisfactory for selected cases of nasal accessory sinus disease, and other selected conditions about the head.

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LVIII

A COMPARATIVE STUDY OF THE SPHENOID SINUS*

(A Study of 1600 Skulls)

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Cleveland

Of all the nasal accessory spaces none is subject to more variations or surrounded by so many important structures as the sphenoid sinus. In this study an effort was made to arrive at the average length, width and depth of the sphenoid, the distance from the anterior nasal spine to the ostium, the distance to the pituitary fossa, the size and shape of the ostium, its distance from the nasal septum and its distance from the cribriform plate. The abnormalities were then recorded—the presence and location of septa sufficient to interfere with drainage, the dehiscences, the indentation of arteries, veins and nerves on its wall. Only those skulls were recorded in which both sphenoids were examined. Of the 1600 skulls examined, 842 were white male, 125 were white female, 495 were negro male and 138 were negro female. These skulls were macerated by live steam, no chemicals being used. They were then grouped according to age and color. It was possible to compare a limited number before and after maceration.

The sphenoid sinus is an extremely variable cuboidal cavity occupying the body of the bone. Its development begins at the third month of fetal life and is complete at puberty. The two sides rarely develop symmetrically and it is not uncommon to find one sinus rudimentary, while its fellow on the opposite side invades the greater and lesser wings of the sphenoid and pneumatizes the pterygoid process.

The average adult sinus has six surfaces, the anterior, posterior, superior, inferior, medial and lateral. The thickness of the walls depends upon development of the sinus, a half millimeter being the average measurement of the fully developed wall. The inferior wall or floor, however, was usually of greater thickness.

On the superior surface, on its antero-lateral wall, lies the optic foramen. The floor of this foramen is usually of parchment thickness, dehiscences being common. The optic nerve is frequently so deeply

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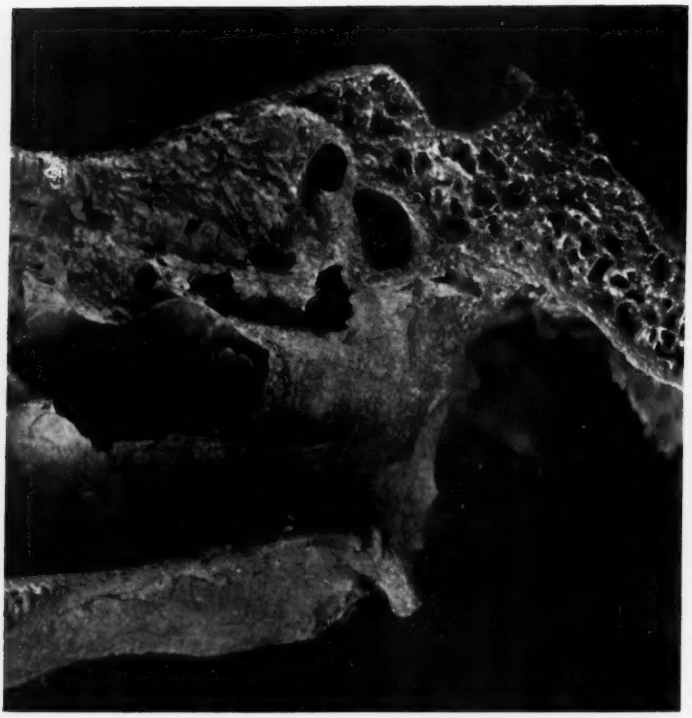

Fig. 1. Small undeveloped sphenoid ostium faces the septal wall.

imbedded in the spenoid cavity that in 7 per cent of the cases examined a large cylindrical ridge showed on the internal surface of the sinus. None of the bony optic canals lay completely free in the cavity, but in nine cases the nerve was seven-eighths surrounded by pneumatization and held to the wall only by a thin plate of bone. Hence it is seen that this nerve, not always covered by a protective plate, is, by its position, extremely susceptible to invasion from an infected sphenoid.

On the postero-superior surface is the sella turcica lodging the pituitary body. The anterior and posterior clinoid processes are often pneumatized so that only a shell-like process remains. However, the posterior wall may be of extremely compact bone 10 mm. thick so that should a pituitary operation be performed by this route, the operator should be prepared to encounter very dense bone.

The median wall, common to both sphenoids, rarely contains dehiscences, but in five instances did communicate by means of an ostium 5 mm. in diameter. The lateral or external surface shows on its posterior aspect a cylindrical indentation for the internal carotid artery. Here again dehiscences are common. In 1 per cent of the sinuses the carotid was distinctly seen on the inner surface. In forty-six sinuses the carotid artery was one-half or more surrounded. On the lateral wall also are found the cavernous sinus and the nerves of the sphenoid fissure. While these are protected by only a thin plate of bone, grooves and dehiscences were not common, probably due to the softer structure of the vein as compared to the nerve and artery. This may explain why optic neuritis is a more common complication of sphenoiditis than is cavernous sinus thrombosis. A cylindrical indentation for the maxillary division of the fifth nerve was noted in thirty-two sinuses. Here again dehiscences were seen and the possibility of neuralgias originating here considered.

The inferior wall is frequently composed of dense bone; the ridge for the vidian canal is not uncommonly seen. Schaeffer[5] reports two cases where osseous dehiscences were present along the course of the vidian nerve. The anterior surface concerns rhinologists most, for it is from this direction that the sphenoid is operatively approached. The anterior wall frequently tilts forward so that the ostium, which is found in its superior third, points obliquely upward. To catheterize this ostium requires an instrument bent the shape of a eustachian catheter. This wall is usually very thin in a well pneumatized sinus. However, the thin place in the anterior wall lies close to the ostium. Frequently the bone immediately below the ostium thickens rapidly so that in the short space of 5 mm. it can be punctured only with difficulty.

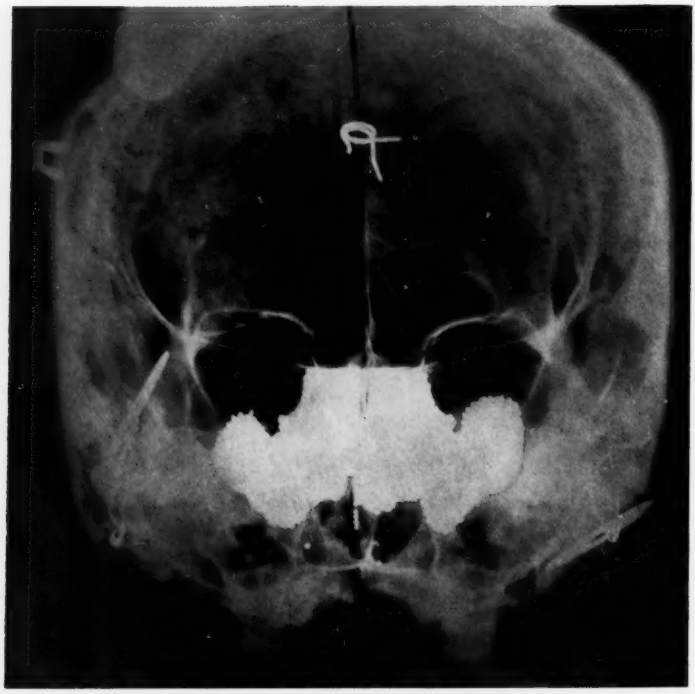

Fig. 2. Large sphenoids filled with shot. Capacity of each sphenoid, 14 cc.

The average distance from the anterior nasal spine to the ostium and the pituitary fossa was as follows:

	Anterior Nasal Spine to Ostium		Anterior Nasal Spine to Pituitary Fossa	
1600 Skulls	White	Negro	White	Negro
263 Female	56.71	57.64	70.20	71.49
1337 Male	60.93	60.60	75.67	75.28

Thus it is seen that the average distance from the anterior nasal spine to the sphenoid ostium and to the anterior surface of the pituitary fossa depends not on race but on sex.

In measuring the sphenoid cavity no rule of measurement could be found in the literature, hence a line parallel to the superior surface drawn from the anterior to the posterior wall touching the floor of the pituitary fossa was taken. This line was usually the maximum depth of the sinus. The vertical measurement, or the height of the sinus, was taken as a line drawn perpendicular to the first line from the superior to the inferior wall just anterior to the pituitary fossa. The lateral measurement was taken at the junction of these two lines extending to the extreme lateral wall. These measurements constantly varied from a rudimentary dimple in the anterior surface of the sphenoidal body to a sinus 35 mm. deep, 30 mm. high and 35 mm. in width. Thus the capacity varied from zero to 14 cc. on each side.

Skillern notes that "the average capacity of the sphenoid sinus may be placed at 5 to 6 cc." Schaeffer[5] gives an approximate average of 7.5 cc. Loeb[6] states that "the cubical capacity varies from 0.6 to 11.8 cc." The greater and lesser wings of the sphenoid, as well as the pterygoid plates, were frequently pneumatized.

The age groups were then considered. As will be seen by the accompanying table, there was no increase in the size of the cavity after puberty. The following measurements are given in mm.:

Age	Number Skulls	Depth Spine to Ostia	Depth Spine to Anterior Pituitary Wall	A. P. Depth	Height of Sinus	Width of Sinus
			WHITE—MALE			
15 to 25	12	60.91	70.08	23.20	20.41	15.25
25 to 35	47	60.40	77.08	22.23	19.68	16.12
35 to 45	167	61.17	71.59	22.90	20.91	17.12
45 to 55	188	61.81	75.69	21.20	16.44	15.82
55 to 65	244	60.53	74.74	20.80	18.90	15.72
65 and up	184	59.00	72.43	20.09	18.44	15.32

Age	Number Skulls	Depth Spine to Ostia	Depth Spine to Anterior Pituitary Wall	A. P. Depth	Height of Sinus	Width of Sinus
			NEGRO—MALE			
15 to 25	46	60.36	72.05	22.39	20.18	19.58
25 to 35	88	60.07	74.66	22.50	20.71	18.21
35 to 45	140	61.81	77.03	21.78	20.32	17.70
45 to 55	135	60.04	74.77	23.00	20.54	18.25
55 to 65	54	60.62	75.94	22.11	19.82	17.73
65 and up	32	60.60	77.27	21.30	20.23	18.64
			WHITE—FEMALE			
15 to 25	2	56.00	67.00	15.75	15.50	13.75
25 to 35	16	56.22	71.10	21.00	18.57	14.16
35 to 45	17	57.18	70.06	16.60	21.24	14.32
45 to 55	32	57.63	71.22	19.61	18.14	15.25
55 to 65	19	56.21	70.59	20.89	18.71	15.90
65 and up	39	57.02	71.33	20.41	18.62	15.50
			NEGRO—FEMALE			
15 to 25	19	56.50	69.92	21.97	20.46	17.98
25 to 35	32	56.96	71.82	21.42	21.20	17.64
35 to 45	38	58.94	72.84	19.68	19.50	16.47
45 to 55	19	59.15	74.36	23.07	21.39	18.31
55 to 65	10	55.40	70.20	18.85	17.60	15.00
65 and up	20	58.90	69.80	21.57	19.72	16.92

The average measurements were as follows:

Race and Sex	No. of Skulls	Depth Spine to Ostia	Depth Spine to Anterior Pituitary Wall	A. P. Depth	Height of Sinus	Width of Sinus
Negro Male	495	60.60	75.28	22.18	20.30	16.68
White Male	842	60.93	75.67	20.81	18.33	16.51
Negro Female	138	57.64	71.49	21.09	19.81	17.05
White Female	125	56.71	70.20	19.04	18.46	15.14

Thus it will be seen that while the depth from the anterior nasal spine to the ostium and anterior pituitary wall varied in the male and female, the size of the sphenoid was larger in the negro than in the white race.

Piersol[1] states that "the length of the average sphenoid cavity is 22 mm., width 15 mm., and height 12 mm."

Fig. 3. A large post-ethmoid cell in which the optic nerve lies almost completely enclosed.

The ostium is usually found on the upper mesial fourth of the anterior surface. The bony foramen may be either round or oval, the proportion being two to one in favor of the round opening. The average diameter of the foramen when round is 5.03 mm., when oval 4.2 mm. by 5.8 mm. The distance from the ostium to the septum varies from one to fifteen millimeters. The average distance from the septal wall to the center of the ostium was 4.92 mm. The distance from the cribriform plate to the bony ostium likewise varies from 1 to 15 mm., the average distance from the cribriform plate to the center of the bony ostium being 8.25 mm. Loeb[6] places the orifice midway between the roof and the floor. As previously stated, the anterior wall of the sinus frequently tilts forward forcing the ostium to face the roof. When, however, the anterior surface slopes backward and down, the foramen then faces the tip of the nose. In several instances a large sphenoid encroached upon the posterior ethmoid space and the ostium then faced inward toward the septum. This foramen could be catheterized only by passing the instrument back along the septum, and then directing it toward the sphenoid fissure.

In the study of the macerated and the nonmacerated skulls, the ostium merits special consideration. Whereas in the dried skulls following maceration the foramen is large, before maceration this foramen was largely closed by a thin membrane and an ostium pin-head in size. This would lead one to feel that true catheterization of the membranous ostium could be accomplished in only a small number of cases. However, this membrane yields readily, while the bony anterior wall is delicately thin, so that instrumental puncture would be no more difficult than that of the maxillary wall. It would be best in all noncatheterizable cases to x-ray the sinus for safety's sake before attempting puncture. In those cases where the ostium was pushed abnormally far from the cribriform plate, a large posterior ethmoid cell was usually causative.

Accordingly, to catheterize the sphenoidal ostium a thorough cocainization is essential, then by placing the probe on the postnasal wall it is passed upward along the floor of the sphenoid to the anterior surface. Here the sense of touch will tell whether the anterior wall is perpendicular or sloping. If the wall faces downward or is perpendicular, the ostium faces forward, while if the surface slopes acutely backward, the ostium will face the cribriform plate. After ascertaining the slope of the anterior plate, the probe is bent laterally to the curve of the middle turbinate and raised to the junction of the septum and the roof. If this roof seems abnormally low, then a posterior ethmoid cell should be thought of and the ostium will be not

Fig. 4. Canal containing maxillary division of the fifth nerve prominently seen on the lateral wall.

far below this cell, approximately 2.4 mm. from the septum. If the junction of the septal wall and cribriform plate were high, then the center of the average ostium would be 8.25 mm. inferiorly and 4.92 mm. externally to the septal wall.

The septal variations on the interior of the sphenoid cavity deserve special study, for it is only by examining carefully their construction that we realize the complexity of the drainage. The septa were part bony and part membranous. In 1000 instances, or 32 per cent, of the sinuses examined, septa were found. Many of these were of sufficient size to interfere with drainage. One hundred of these sinuses had two or more septa. These sprang from every surface and in every conceivable variation, dividing the cavity into medial, lateral, superior, inferior, anterior and posterior cells. In some instances a middle sphenoidal space would be added. This communicated by an ostium varying from a few millimeters to almost the size of the sinus. The most common septum joined the superior and inferior wall posteriorly, and as such would not greatly hinder drainage, but would have to be considered if radical surgery of the sphenoid were contemplated.

Congdon[3] feels that "the form and position of many septa indicate in a striking manner the origin from synchondroses. The septa do, of course, strengthen the walls but are only accidental."

Barnhill[4] states that "incomplete septa frequently are present in the sphenoid sinuses and create pockets which interfere with drainage. More important than these pockets, from the standpoint of drainage, is the occasional pocketing produced by extension of the sinuses into the wings of the sphenoid and into the clinoid and pterygoid processes; for, when infection of such widely extending sphenoid sinuses takes place, it is obvious that dangerous conditions may arise which are impossible to reach or relieve." Schaeffer[5] feels that these recesses obviously retain infectious material despite the establishment of good drainage surgically. He then warns of the danger of spreading the infection by breaking into these cavities.

In noting the abnormalities of the sphenoid and evaluating their significance to the rhinologist, the abnormally placed posterior ethmoid cell would be of first importance. In fifty-five skulls this cell occupied the superior part of the sphenoid, had pneumatized the space about the optic nerve and partially enclosed it. In a few skulls both optic nerves were surrounded by the one ethmoid cell. Hence in cases of optic neuritis both the ethmoid and sphenoid should be considered. Likewise, when we consider the inadequate protection given

Fig. 5. Right sphenoid divided into superior and inferior cavities. The inferior drains into superior portion by a minute ostium, 1 mm. in diameter in the anterior surface of the dividing wall.

by the walls to the important adjacent structures, we become reluctant to advise any forcible removal of the lining mucosa.

Here again the operator should keep in mind the abnormally large as well as the rudimentary sinus. These occur often in the same skull and may be so placed that an x-ray will not disclose their presence. Finally the rhinologist should consider the difficult task of diagnosing and treating pathology in this sinus. Here is a cavity, located near the center of the skull, capable of holding 30 cc., whose thin walls are often indented by most important structures and opening by a minute ostium, the position of which renders drainage difficult. This type of cavity, dangerous to curette, divided by septa and often impossible to explore completely, stand as a challenge to the best efforts of the rhinologist.

In concluding, I wish to thank Dr. T. Wingate Todd of the Department of Anatomy, Western Reserve University, for his kind permission to examine these skulls in the Hamann Museum and for his helpfulness in this study.

1027 ROSE BUILDING.

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LIX

AN EVALUATION OF THE DISPLACEMENT METHOD WITH A REVIEW OF THE LITERATURE

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SAINT LOUIS

Twelve years have elapsed since the principle of displacement was first suggested as a means of introducing fluids into the accessory nasal sinuses. In the interval, it has been widely accepted, and much that is of interest has been written about it in this country and abroad.

The time seems ripe for an evaluation of the method, based to some extent upon the author's experience, but resting chiefly upon that of others, as expressed in published articles, and in a large number of inquiries and personal comments. Not infrequently these have revealed minor errors in technique or interpretation which have resulted in something less than the successful therapy or diagnosis which might have been attained, wherefore this paper is planned particularly for those in whose hands displacement has proven impractical as well as for students desiring to perfect their technique.

Some variations in the positions and solutions, and some new instruments have been suggested, but basically the technique remains unchanged. Certain formerly suggested procedures, such for instance, as the prone position for the filling of the frontal sinus, and the use of stained oils for determining emptying time, have been abandoned as impractical.

In regard to general diagnostic considerations one has the feeling that most rhinologists are unwilling to give the time and effort required for proficiency in the interpretation of radiographs. Certain it is that the properly made film presents considerably more information than is usually gleaned from it in the course of a routine examination, which is a pity. Wolf[26] makes an observation which should be engrossed and hung on many a wall, when he says, "If we would give our patients nearly as much attention before operation as we do after, our results would undoubtedly be much better." One can scarcely be justified in condemning a method on the ground that some proficiency is required for its full appreciation.

TECHNIQUE

Even in so simple a procedure as a displacement filling one may slip, to the detriment of his results.

As has been stated, four conditions are indispensable to a proper displacement filling:

1) the ostium must be in proper position relative to the sinus;

2) the ostium must be covered by the fluid;

3) negative pressure must exist at the ostium and

4) the ostium must be patent.

The first two requisites are assured by maintaining the patient's head in the proper position. This has been described as "inverted so that the chin and the external auditory canals lie in the same vertical plane." It has been found by experience in a large number of cases that some heads fill to better advantage if the extention is somewhat exaggerated. This was first recommended by Fraser as long ago as 1927, and is now practiced routinely by many laryngologists.

Parkinson[15, 16, 71] prefers to prop the patient's shoulders on a pillow and suspend the head laterally, the patient lying on his side. This also works satisfactorily. The details may follow the whim of the operator in this respect, so long as the sinus depends below its ostium, and the latter is well submerged.

Failure to bring the head into the required position may be due to the use of a chair or table unsuited to the requirements.

Neglecting to submerge all the ostia before suction is applied, accounts for many of the failures to fill antra properly. The statement is often met with, that displacement fills the sphenoid and posterior ethmoid cells but leaves something to be desired in the case of the others. If the nasal chamber is not completely filled before suction is applied, the maxillary ostia may never be submerged at all, or may be covered only for a single exchange of pressure, after which the sphenoids at the bottom of the chamber fill at the expense of the rest. It is good practice to fill the nasal chamber to the nostril before any suction is applied. Using a medicine dropper instead of an adequate syringe may account for poor anterior filling.

The poorest sort of suction device will serve to fill the sinuses after a fashion, which may lead the operator to be satisfied with something less than he should expect, or, on the other hand, may cause him to abandon the method.

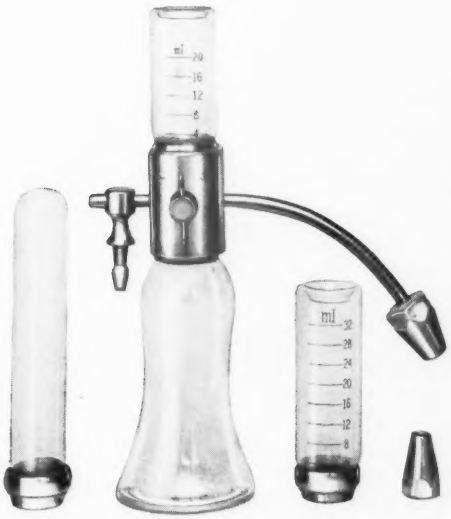

Fig. 1. Apparatus of Schillinger.

Two really essential things should have his first attention. There should be available constant negative pressure which can be regulated to approximately 150 mm. (mercury), and the hole by means of which it is interrupted should be quite large, in order to insure prompt and complete fluctuations. The glass syringes with rubber bulbs which were originally used have the advantage of portability and initial cheapness, but for routine office work they are not very satisfactory. It requires considerable skill to time the patient's closing of his pharynx to the short period of suction which these syringes afford, and the bulbs deteriorate, reducing the suction materially.

The various water-tap devices and the electric pumps are most satisfactory. The tips used should have adequate openings and the thumbholes, as stated, should be large enough to permit complete equalization of pressure when the thumb is removed. Immediately continuous with the tip there should be a glass reservoir for overflow. This last is of great assistance in treatment, as will be shown. The ordinary Sorensen goose-necked, glass tubed suction tip is used by most operators. Schillinger[19] has modified it for the special purpose of displacement, to some advantage. (Fig. 1.)

Fig. 2. Apparatus of LeMée.

LeMée has devised a special metal tip which is in general use in Europe. (Fig. 2.) It has an exceptionally wide control opening and an extra tap for connection with an aneroid gauge to indicate the amount of negative pressure. It has the advantage of being readily disassembled for cleaning, but lacks the glass chamber for observing the secretions removed. The use of the gauge is an excellent safeguard for beginners, though not a necessity in careful hands. For the sake of portability in the clinic, Monti has built a special stand for his equipment. (Fig. 3.) He has also a small metallic suction chamber which attaches to any standard syringe (Fig. 4) and seems very practical. Davis[4] has devised suction apparatus and a folding treatment table for use where space is limited, or even by the patient at home. Thomas[23] employs a mercury manometer which he considers an essential part of his equipment.

The author's metal combination syringe was designed chiefly for the use of those who are required to work without an assistant. It does away with the necessity of having to change from syringe to vacuum tube and back twice while the patient is in the inverted position, but it also lacks the glass reservoir. Someone has modified this syringe by introducing a glass window *into the oil container!*

Fig. 3. Monti's apparatus.

This does not seem to me to add anything to the original syringe which had its calibrations marked on the piston rod, and it adds one breakable part.

An all-glass tip which has given satisfactory results to Kreutz of the Henry Ford Hospital, Detroit, is illustrated in Fig. 5.

No instance has ever come to my attention of any accident resulting from the application of the recommended negative pressure with the head in these dependent positions, even in patients with hypertension, but the possibility is always before me and I refrain from using the method in questionable cases.

Excessive negative pressure is to be avoided. Even the amounts commonly used for suction in the upright position are, to my mind, dangerous, not to add futile. Skillern has reported cases of submucosal hemorrhages in the frontal sinuses following suction applied in the attempt to empty the frontal sinuses. Gordon[6] reports a similar serious accident.

Sternberg and Satz,[22] in order to dispense with apparatus altogether, put the patients in the Proetz position, filled their noses with 10 per cent iodipin in petrolatum and allowed them to manipulate the positive and negative pressures by the Valsalva maneuvre. They failed, at first, to obtain satisfactory filling because they limited their experiments to allergic cases which we now know are notoriously difficult to fill. They did this because they felt that manipulating the nasal chambers in cases of purulent sinusitis might set up a purulent otitis media. This fear proved to be unfounded.

These authors state further that they hesitate to report on frontal and maxillary sinuses because the filling was not great. This observation is discussed here because it represents the experience of some observers, to whom the author wishes particularly to stress the fact that relatively slight fillings are sufficient for diagnostic purposes, and usually preferable to more extensive fillings. Sternberg and Satz state that complete filling was their goal. They examined twenty-five cases. By moving the heads in all positions, they filled ten sphenoid sinuses completely and six partially. Of the twenty-five pairs of ethmoid sinuses they managed to fill fifteen, which seems

Fig. 4. Monti's suction tip adapted to record syringe.

uncommonly good, considering that all their patients had allergic rhinitis. They found that when they were able to fill the ethmoid sinuses in these cases, the frontal cavities were also filled. They tried with varying success to fill the obstructed sinuses by shrinking with cocain and adrenalin. It is of interest to record that while these experiments were in progress, Prof. Marschik with whom the authors were associated, visualized the adenoids radiographically while the patients were lying in the supine position.

They made the observation that headaches, though sometimes temporarily increased, usually disappeared, and that this commonly occurred by the third day after the filling. In some cases, this relief was temporary, but in many it was of long duration. They pointed out that this information was volunteered by the patient and was not asked for. They conclude, among other things, that the method indicated definitely whether or not the ostia were permeable.

Greenfield[7] puts the patient's head over the edge of the table and allows it to remain there for ten minutes. Then he is returned to the upright position and suction is applied. The rationale of this procedure is not quite clear to me, since the ostia are obviously no longer submerged when the suction acts. I mention it only to caution the student against keeping the patient in the extended supine position longer than a minute or two, as severe and sometimes protracted headaches may result.

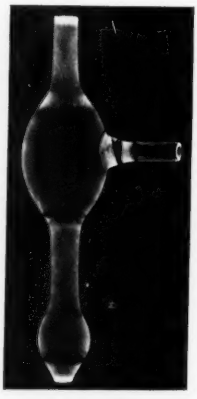

Fig. 5. Suction tip employed by Kreutz.

LeMée,[11] who has a large experience in the teaching of the method, lists the following as the principal errors in technique which he encounters:

1) the use of the wrong radiopaque, resulting in irritation and headache,

2) the use of a cannula not adapted to the nose,

3) failure of the patient to close the pharynx,

4) excessive or insufficient vacuum, the first causing pain or hemorrhage, the second insufficient filling,

5) some malposition of the head.

Richier,[18] finding much variation in the filling of the ethmoids, attempted to establish some standard routine for the best filling. At the Hôpital Necker he performed his experiments upon thirty subjects with apparently normal noses. Checking the viscosity and concentration of the fluids, the degrees of negative pressure, the nasal tip, the position of the head and the number of alternations of pressure, he reached the following conclusions:

1) The "ascending" type of lipiodol enters the sinuses better than the "descending" type. A ten per cent concentration is the minimum for the required contrast.

2) The constant suction pump is decidedly more effective than the rubber bulb.

3) Eighteen centimeters (mercury) is the maximum negative pressure to be used. The rapidity with which the peak-pressure is reached is more important than the total pressure.

4) The best position is a slight exaggeration of the Proetz position.

5) Four cc. is sufficient for one nostril. An amount exceeding this will not increase the filling.

6) Eight alternations of pressure are better than fewer, or even more.

7) Release of suction must be prompt and a long interval between pressure alternations is recommended.

8) The chief sources of obstruction are deviated septa and hyperplastic turbinates.

9) Most sinuses blocked by hypertrophied membranes can be satisfactorily filled after shrinking with cocain and ephedrine, but in such cases the emptying time observations will be unreliable.

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SOLUTIONS

On the subject of radiopaques, little is to be added that is new. Some of them have lost favor either because of an unsuitable viscosity or a tendency to become rancid. A few of the original solutions are now standard, and there is not much choice between them. The chief considerations regarding them are that they should be inert and stable, and of a known viscosity; that is, the operator should have knowledge of the average emptying time of the fluid employed.

The author now routinely uses a one to three dilution of iodized oil, as recommended by Fraser,[32] and believes that in certain cases even a greater dilution would be preferable. This overcomes the objection of Hurd[34] and others[87 108] who have regarded the use of radiopaques as disadvantageous because of the possibility of their flowing around a mass and obscuring it. These authors recommend stereoscopic views instead, but we feel that if one is to take two views, a postero-anterior and a lateral view will often give information which the stereoscopic one will not.

Various authors have used colloidal silver salts as radiopaques and found them serviceable.[42] They are less dense than the oils and if retained, may become quite irritating.

LeMée[37, 38] believes that the elimination of iodized oil may take place through the lymphatics as well as through the sinus ostium by the aid of the cilia. He carefully cleansed the nasal chambers after displacement and retained the patient in the supine position until this was done to guard against swallowing and intestinal absorption. He makes the statement that iodine thus absorbed may be recovered in larger quantities and for a longer time from the urine than from a similar amount ingested. I have been unable so far to find this confirmed by other investigators.

Causse and Bouchet, in discussing this paper, say that they find a similar elimination following the injection of the inferior turbinate with lipiodol for ozena. I do not consider this comparable, as the selective action of the mucosa, which is the important consideration, is lacking in the latter case.

Fenton[29] has observed two persons in whom symptoms of hyperthyroidism seemed to be exaggerated following the use of iodine-containing oils.

Houser[33] used displacement chiefly for posterior ethmoid and sphenoid studies and had the experience that on several occasions when the patient was allowed to assume the erect position, the oil escaped before the films were made. This is a puzzling situation and one is inclined to wonder whether filling actually occurred in the first place or not, or whether possibly too much filling was expected. This thought is injected only because our own experience, even with widely opened sphenoid and maxillary sinuses, is that a certain amount of oil clung to the walls and was distinctly visible.

Houser found that campiodol, diluted with equal parts of olive oil, gave him the best results. The viscosity of this preparation is less than that of a similar lipiodol dilution and is therefore more easily introduced into the sinuses.

It may be well to remind clinicians that variations in the viscosity of the oil will result in concomitant variations in the emptying time and that diagnostic deductions must be based upon the standard emptying time for a given solution.

Williams[36] fears that the "injection of lipiodol into the sphenoid sinus is injurious and one to regard as dangerous and cause for concern," adding that lipiodol is to be used "more in the surgical cases, for when we can show a picture, it is never difficult to get a patient to

consent to an operation." With their efficacy in breaking down sales resistance, I have no experience, but if these oils are dangerous there is no intimation of it in the innumerable published records of sinus injections.

For treatment purposes, many solutions have been suggested and used. These fall into three classes: astringents, antiseptics and antigens. Most of these will be discussed under the heading of treatment in connection with their results. One or two, however, should be mentioned here.

Fitzhugh[30] has published his observations of the use of neosynephrin hydrochloride by displacement in the treatment of chronic sinusitis. After reporting a series of fifteen cases in detail, he concludes that a .125 per cent solution of neosynephrin hydrochloride does not protract vaso-constriction longer than does a .25 per cent solution of ephedrine hydrochloride, although in certain cases it is less toxic. He finds that "although neosynephrin hydrochloride is somewhat more expensive than the solution of ephedrine hydrochloride, it can be used in those cases in which the patient is sensitive to ephedrine and should be substituted intermittently for the regular Proetz solution in cases in which long periods of treatment are required"—presumably in order to avoid developing a tolerance for either drug.

Layman,[35] in 1929, irrigated antrums by displacement after packing the posterior half of the nose with absorbent cotton slightly impregnated with mineral oil. This procedure was applied especially to acute cases. He found it of advantage to instill at first one to two cc. of the solution of ephedrine and cocain. Warm saline solution was employed for the irrigation.

Shambaugh[40] found a .25 per cent solution of ephedrine sulphate in physiological solution of sodium chloride quite as effective as the .5 per cent solution which I had recommended and less likely to produce an ephedrine reaction. Following his example, I now use this strength routinely, and prefer it. The total dose of ephedrine which the patient receives in the case of the .5 per cent solution is roughly .6 grain; with the .25 per cent solution it is .3 grain.

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TREATMENT

It is in the field of treatment that displacement has been of greatest service. That the introduction of treatment solution actually into the sinuses should be more effective than a mere nasal application is to be expected. The caution with which the method was first approached was prompted by the possibility that the various fluids remaining for several hours in contact with the mucosa might do it harm. This is not the case, as experience has shown, provided that the more irritating solutions are avoided. Many solutions are being employed by various rhinologists, but in the main it may be said that

the simple constrictors in dilute, usually isotonic solutions, have served best.

Arslanian and Valette,[41] working in Portmann's clinic, use iodized poppyseed oil 40 per cent, or strong or mild silver protein. They report fifteen cases with good results in all. They allowed the negative pressure to mount to 240 mm. of mercury. Treatments were given at four and five day intervals and were founl by them to be especially effective in children.

Bouchet and Mazarakis[46] use isotonic solutions of various compositions, colloidal silver, protargol and lipiodol with olive oil. On occasion they have employed weak anesthetic solutions. Among these, 1 percent cocain solution was found to be ineffective. Butylene was badly tolerated. Their experience is that the first day following a filling, the head is heavy, on the second day secretions appear in the pharynx, followed by an interval of relief beginning on the third day.

C. K. Beck reports that 5 per cent solution of neosilvol was ineffective, and one-half of one per cent solution of mercurochrome was followed by severe local irritation, nausea and headache lasting about twenty-four hours.

Baum[45] cautions that displacement cannot be depended upon to fill sinuses in the presence of allergy. This is in accord with the author's observation[73] that "while the complete failure to fill may hardly be advanced as pathognomonic of allergy, it is so striking as to be highly suggestive. Small amounts of fluid may be made to enter, however, by preliminary shrinking." This procedure has on occasion been of great service in relieving acute attacks of seasonal allergy when local applications have failed.

Frazee,[50] observing the emptying time in a series of twenty cases, states that "check-up plates made seventy-two hours after the introduction of the iodized oil show some fluid remaining. This is what Proetz terms delayed emptying."

I wish to caution the reader that actually my observations showed[73] that, using iodized oil of a specified viscosity, ninety-six hours were required for the sinuses to empty themselves. The seventy-two hour period was adopted as routine not only for convenience and expedition but also because some small amount of fluid did remain to indicate the position of the cells under observation. This author has also the impression that I advise surgical treatment for sinuses which do not admit fluids. In a measure this is true, but it should be understood that by fluids I mean all fluids and not only radiopaques.

Many sinuses which will not admit radiopaques can be made to accept ephedrine after shrinking, and it is often in these cases that the greatest good may be expected.

As Frazee has applied the method, he has not found it to add any important findings not previously shown in his routine roentgen examinations, but his experiences with treatment have been somewhat better. Sixty-three per cent of sixty-eight patients with headache were improved. In seven cases the headache was increased.

In the management of headache, the apparent paradox has been encountered that the greatest ultimate relief is achieved in those patients who complain of headache after the first instillation. One can only surmise that this is due to the fact that the headaches occur in cases of relatively active inflammation in the sinuses or in those which have long been blocked, and which do not accept the solutions without pain. Old hyperplastic membranes, on the contrary, are inactive, not painful, and are less likely to yield to treatment. The severe headache following the initial displacement does not contraindicate a second two days later, which is commonly much less painful. Subsequent displacements are usually not followed by headache; in fact the headache disappears altogether.

A single irrigation often brings this about. Granger[73] first called my attention to this following an injection of lipiodol. Shambaugh[76] says "a single irrigation has cured a sinus infection of years' duration. Usually a series of a dozen or more irrigations are necessary before the washing is negative, and the symptoms disappear. Even where the initial irrigation produces liquid pus with a foul odor, the chronic infection may be cleared up with irrigations alone, so that in every case of chronic purulent maxillary sinusitis, simple irrigations should be given a trial and chronic ethmoiditis sometimes responds to repeated evacuation by the displacement technique." This author also finds it of use in the diagnosis of ethmoid disease.

Ridpath[74] found the method effective in a case of frontal sinusitis following influenza.

Shuster and Shuster[75] point out that displacement is to be used, in acute sinus infections, only as the acute symptoms subside.

Davis[4] points out that the method acts more quickly in children than in adults; that in order to be of benefit is must be used several times a week and sometimes over a long period of time.

Iglauer[78] finds it possible to introduce fluids into otherwise inaccessible ethmoid cells and to free them of their retained secretions.

He regards the use of opaque oils in this region as advantageous in diagnosis.

Winfred Post has had satisfactory results in ophthalmologic lesions secondary to acute posterior nonsuppurative sinusitis and pharyngitis. He employed the treatment daily for a week, although the pains became negligible much earlier. In a case of acute iritis, the exudate into the anterior chamber began to recede after the second treatment, and was clear on the eighth day.

Theobald,[77] discussing a paper of Vail, describes the case of a woman, aged 30, who was rapidly becoming blind in one eye through a retrobulbar neuritis. On the affected side, the sphenoid refused the oil. He expressed the opinion that "whether there was a thickened mucous membrane or not was not of importance. The sinus was completely blocked. She was operated upon and counted fingers on the third day and read a newspaper inside of a week."

Wagner[82] feels that the important factor in displacement is the dilution of the pus, which facilitates its removal, although at times he has difficulty in making the fluid enter the sinus. The solution of his choice is one of physiological sodium chloride. The same author,[83] as late as 1936, states that his radiographs of the ethmoids are unsatisfactory and that it is impossible to irrigate these cells. Others, however, have succeeded in filling them fairly routinely, and many prints of radiographs showing them well filled may be found in the literature. (See for example Figs. 6 and 7.)

Extremely useful to me in the matter of prognosis is a simple procedure, which, for want of a better name, we call "washing through." Immediately after the completion of the displacement treatment, and before the patient moves, continuous suction is applied at one nostril while a syringeful of the treatment solution is poured into the other. The effect of this is simply to draw the nasal contents, with whatever may have washed out of the cells, into the glass container of the suction tube where it may be studied.

The back-and-forth movement of the fluid through the ostium of the inverted antrum is often so effective in emptying it of pus that the displacement can effectively replace the cannula or the trochar.

When the contents appear in the glass tube as the result of the "washing through," the following changes are the rule:

Fig. 6. Radiograph, lateral view, showing average filling. Normal mucosa.—(Courtesy of Dr. E. C. Ernst.)

After the first washing, the antrum contents are apt to be in the form of a single large opaque yellow lump, floating in the washing fluid.

After the second washing the lump gives place to a series of ropes, still yellow and still opaque when the tube is held up to the light.

After the third or fourth washing, the material consists of a few curds which settle to the bottom of the tube.

This is followed by what appears to be clean wash fluid, but what on closer inspection and upon slowly pouring it out, proves to be clear heavy mucus. (See Fig. 8.)

Fig. 7. Radiograph, lateral view, showing average filling. Chronic purulent pansinusitis.—(Courtesy of Dr. E. C. Ernst.)

Treatment should not be suspended at this time, or recurrence will almost surely follow. It should be continued until the thick masses of mucus no longer appear.

With these progressive changes in mind, it is my practice to continue displacements every second day so long as improvement is definite. If conditions do not advance from any stage to the next after a few displacements, the method is abandoned for something more drastic.

Curiously, Liggett and Caldas have independently found displacement the most successful means of evacuating the sinuses of

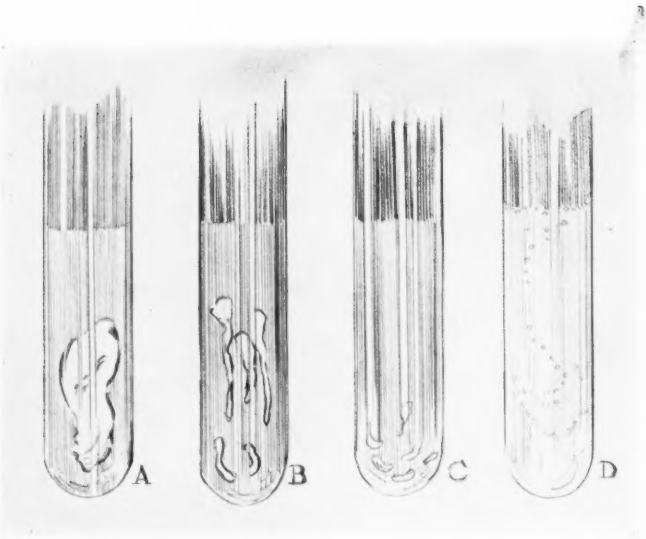

Fig. 8. Appearance of the secretions gathered in the tube after "washing through." *A*—First stage, solid opaque mass of exudate. *B*—Second stage, still opaque but in shreds. *C*—Third stage, material scant and curded. *D*—Fluid clear, but heavily charged with mucus.

larvae. Liggett[65] saw a 15-year-old girl who complained of a copious nasal discharge. There was also a hawking of pus, always preceded by a tickling sensation in the roof of the mouth. A vigorous attempt to clear the throat brought up a living insect about 1 cm. long, dark brown and many-legged. This happened about once every two to four weeks. Sometimes two, rarely three, insects appeared. On a previous occasion, three or four months before, she observed six or seven worms entirely different from these parasites. They were quite small and had no legs. Roentgenograms of the sinuses were negative. It seemed certain that the parasites were lodged in the right maxillary sinus. However, a radical operation was done on both sides. The left antrum appeared normal except for a slight thickening of the mucosa. The right was filled with a mass of polyps and necrotic tissue. Fluid pus was present, and although the cavity was curetted in its entirety and a careful search was made for larvae, none were found. No ova or parasites were found in the tissues removed.

The headache was now more apparent in the occipital region. Accordingly, under local anesthetic, the sphenoid sinuses were punc-

tured and the openings bitten out with punch forceps. Irrigation of these sinuses, however, failed to produce any larvae, although the washings from the right side were cloudy and contained mucopus, epithelial cells and cholesterol crystals. Within ten minutes after this procedure the patient blew three living insects from her nose. Subsequent irrigations produced two or three more parasites. To facilitate the washing, the right middle turbinate was excised. Finally the patient was subjected to a displacement filling, using a commonly employed oil prepared after a formula of Coakley. The paper was written nine months after this treatment and no further larvae had been seen. The insect was identified by an entomologist of the Smithsonian Institute as the larva of the black carpet beetle (*attagenus piceus* Oliv.). This larva takes two years to reach the adult stage.

Caldas[47] reports three cases of nasal larva treated by means of displacement. In the tropical regions, according to this author, myiasis of the sinuses is not rare among the rural population. The flies are usually the *musca domestica, sarcophage ruralis* and *wohlfartia magnifica*. When the larvae reach the interior of the sinuses, the condition is curable only with great difficulty. The usual treatment consists in washing with some lotion and then extracting the larvae with forceps. This treatment is insufficient, because many of the invaders are left behind in the nasal cavities.

This author has experimented with various larvicides in vitro, including various coal tar derivatives, oxycyanate of mercury, corrosive sublimate, 10 per cent carbolic acid, iodoform in liquid vaseline and iodoform in ether. He found that these did not kill the larvae but often increased their movements. The effect of these preparations in the nose has been merely to drive the larvae out of the sinuses into the nasal chambers, whence they could be removed with forceps. In order to reach all of the sinuses simultaneously, Caldas introduced an "iodoformed paraffin oil 5 per cent" by the displacement method. In the three cases reported, all the larvae were quickly washed into the nose and removed. In each case the patient returned several times during the first twenty-four hours to have more insects taken away. In each case also the process was complete within that time and no further larvae appeared.

Of late much interest has been directed toward the effects of various biological preparations upon the sinus mucosa. Amano[43] writes of ten patients with chronic paranasal sinusitis and one with ozena treated by displacement every two or three days for several months, using autogenous vaccines and antivirus. These treatments

were supplemented by occasional packs with the same materials. Seven showed improvement, four did not. The results were not sufficiently striking to permit of drawing conclusions, but the author suggests that this may be a step toward the improvement of present-day methods of treating these troublesome diseases.

Kracaw,[60] in 1934, employed displacement for filling the posterior sinuses with antigens prepared according to the Krueger methods. In a series of 45 cases, 95 per cent showed satisfactory improvement, and 66 per cent a very pronounced improvement or cure. Continuing his studies in 1936,[61] "application to the sinuses every fourth day is effected by the Proetz displacement technique. This is adequate for the treatment of the ethmoidal and sphenoidal sinuses, and if properly carried out results in instillation of some of the antigen in the antra. * * * Local reaction manifesting itself in slight nasal obstruction, and in some cases by mild headache, follows the first few instillations. As treatment is carried out the drainage increases and becomes purulent—a favorable indication, since the antigen apparently acts by stimulating phagocytosis. Finally the drainage becomes mucopurulent and gradually diminishes in quantity."

Hosmer,[56] discussing Kracaw's work, reports his own successful results and mentions the necessity for thorough shrinking before administration. He finds the "lysate superior to antiseptics such as mercurials or phenol in oil."

Laskiewicz[62] treated ethmoiditis with a complicating maxillary sinusitis in an infant as follows: He put a polyvalant antivirus with adrenalin into the nose. On the second day, the temperature remaining at 38°, he introduced 2 ccm. of antivirus by displacement. On the third day the temperature dropped to 37.5° and the mucosa improved in appearance. A second displacement was given the following day, after which the infant left the clinic practically recovered. He then conducted a parallel series, comparing the effects of disinfectants with those of antivirus. In three cases the infection disappeared in three to five days, which were the most satisfactory results of the various treatments, and were accomplished with the use of antivirus by displacement. He feels that "this method covers a vast domain of application in the treatment of sinus infections."

Gundrum and Semenov,[52,53] in two comprehensive articles, describe their observations on 150 cases treated by displacement with ephedrine .5 per cent. Fifteen to twenty instillations were given in each case. Fifty-two per cent of the cases were definitely improved (that is, relieved of headache, postnasal drainage and obstruction).

Sixteen refractory cases which failed to show improvement were treated with a stock bacterial antigen filtrate prepared from staphylococcus, streptococcus and bacillus coli according to the method of Bezredka. Eleven of the sixteen cases improved after the addition of bacterial antigen to the ephedrine solution.

One hundred and thirty-five additional cases were treated, using stock bacterial antigen with ephedrine from the beginning. In this series 64 per cent improved.

Eleven cases were treated with undenatured autogenous antigen according to the method of Kracaw. In this series the results were no better, only six of eleven having definitely improved. They add the important observation that bacterial filtrate and bacteriophage are quite irritating to the sinuses and not infrequently bring about severe reactions. For this reason they begin with dilute solutions. They conclude that "beneficial results obtained with dilute ephedrine in physiological sodium chloride solution, as advocated by Proetz, can no longer be open to doubt. The shrinkage action is smooth and protracted and the total quantity of ephedrine which is given in the routine treatment seldom creates undesirable symptoms; as a matter of fact, few systemic effects have so far been observed * * * the best results are obtained in the subacute catarrhal type of sinusitis." They feel that the addition of a dilute solution of bacterial antigen can be made without discomfort to the patient. If progress justifies the continuation of the antigen, the concentration may be increased until a 50 per cent solution is obtained. By this method definite improvement was noted in more than 64 per cent of their cases.

With any solution the percentage of improved cases varies so greatly from month to month, and from epidemic to epidemic, that these figures seem to me to fall well within the average fluctuation. Frazee, for instance, cited above, reported 63 per cent favorable results without using antigens, and my own results are comparable.

Monti[69] has found the method satisfactory, using a polyvalant antivirus. Parkinson[71] has used bacteriophage, but I do not know his results.

Hirst feels that it is practically impossible to infect a normal sinus in the course of treatment, but on two occasions suspected that there was a subacute exacerbation of a chronic ethmoiditis and chronic maxillary sinusitis. The maxillary sinusitis had been quiet for a long time. Following this experience, he has routinely douched noses

with physiological sodium chloride solution before giving a displacement treatment.

Mignon[68] has attempted displacement in the ear in cases of otitis media. This report is mentioned for the sake of completeness and without any wish to advocate the treatment. I know of no one else who has attempted it, and should not regard it as being free from danger.

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RADIOGRAPHY

Whether the use of radiopaque substance adds anything to a radiograph or not has been discussed far and wide. My own conclusion is that some radiologists are stating the truth when they say that they cannot uncover any additional information through the use of radiopaques. On the other hand, I am convinced that others can and do. Of the first group, not one, so far as I can discover, makes any reference to the physiology of the sinuses. Granted, as I have often repeated, that the topography of the sinus—bone, membrane and exudate—is an open book to these men, there remains still the question of the ability of the sinus to empty itself, which can be determined only by watching it do so. And this is what the rhinologist requires, above all else, to know. If anyone has succeeded in determining this without radiopaques, I can find no mention of it in print.

Much of the adverse criticism of the use of radiopaques has come, as may be seen by studying some of the published illustrations, as the result of faulty technique or through a misconception of what is to be expected. In the early days, the chief trouble was the use of the x-ray beam projected vertically upon the pool of oil.

Through the writings of such men as Ernst,[89] Baum[73] and Israel[98] in this country, Graham-Hodgson[94 95 96] in England, Sourice,[102] Gunsett et al.,[97] and LeMée[100] in France, and Vock[104] in Germany, the use of the horizontal beam with the patient in the upright position has, within a very few years, become standard practice. This eliminates many errors of judgment in the interpretation of filling defects, more especially those resulting from evenly thickened membranes.

Another common source of failure was the desire for complete filling and metallic shadow density. This produced a dramatic contrast as viewed from across the room, but it obliterated much that was essential, and, I am sure, was the cause of much adverse criticism. The remedy is, of course, a fluid of low opacity, and a partial filling. One or two cc. or less will suffice to indicate the emptying time of a cell, and it will do something else, seldom referred to by its critics, it will flow into the most unexpected pockets and ramifications, demonstrating extensions of sinuses into regions quite unsuspected in the "straight" film. I know that it will be said that a competent radiologist can outline these without the oil. Experience makes me doubt that there are many who can do so.

Even with the help of the oil, it is often necessary to resort to two views for a proper interpretation. Beeler, in discussing a paper of Bundy Allen,[87] stresses the importance of taking two views routinely. When one considers the difficulty of identifying even a familiar person by his shadow, unless it happens to be in frank profile, the limitations of the one-view routine become evident. Carmack's[103] chief difficulty was that the very cell which interested him most was often the one which did not fill!

Fraser[91] considers that the observation of delayed emptying time has merit, and suggests keeping some sort of protocol of the patient's activities and postures during the seventy-two hour observation period. It is his experience also that the nonsuppurative type of infection tends toward pan-sinus distribution, to demonstrate which, with radiopaques, displacement is necessary.

Glaser, Futch and Snure,[92] in 1929, studied the literature for opinions on the reliability of simple x-ray studies, and found many reports of negative x-ray findings in sinuses which at operation were found to contain pus, and many more which were found to be not diseased in spite of increased density to the rays.

Goodyear[93] stresses the importance of maintaining the same angulation in the making of the 72-hour exposure as the one employed for the initial one, in order to avoid errors in interpretation.

LeMée once showed me a film in which flecks of radiopaque oil could be seen deep in the cervical tissues following a displacement. In his large experience, it was the only one, and it is difficult to explain how it may have come there. Pfahler[101] reported a similar distribution following antrum puncture. While he attributed this to absorption of the oil by the sinus mucosa and a final collection by the lymphatics, a study of his published radiographs leads one to regard an accidental submucosal injection of the oil as the more likely explanation. He also finds no other case, either in the literature or in his own files. It would seem that if true lymphatic drainage of iodized oils could occur it would have been observed more frequently among the hundreds of thousands of patients injected in the past thirteen years.

Bedford Russell has made the observation that on some occasions a sinus with a thickened mucosa has emptied itself of its oil in shorter time than its fellow, which showed no such thickening, and raises the question whether or not ciliary activity may at times be greater in an inflamed sinus than in a normal one. I have no answer for him as regards the modus operandi of the phenomenon, but regard his discovery, that thickened membrane and physiological emptying do not necessarily go hand in hand, as extremely important. I submit that this contribution could never have been made without the use of a fluid radiopaque.

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INTERPRETATION AND DIAGNOSIS

Competent diagnosis from films made with radiopaques is the most difficult phase of the displacement method, and requires both judgment and experience. However, it seems to me that the results are well worth the study. Only in the dissecting room is one confronted so forcibly with the endless variation in sinus distribution. In the flat film there is always the tendency to select from the shadows those which conform to the text-book description, often with considerable error.

Before discussing the literature, it may be well to note briefly a few of the characteristics of membrane outlines which are of diagnostic importance. Aside from the density and thickness of the membrane, its outline as related to the bone outline is indicative of the pathological change present.

An edematous membrane, an allergic one, or one acutely inflamed, swells relatively suddenly.[73 106 113] The connective tissue network of the submucosa yields here and there in the areas of least resistance, producing a group of surface bulges. The resulting shadow is a series of convexities distributed more or less at random. The important character of such an outline is that it does not run parallel to the adjacent bone shadow, in fact it usually has no relation to it. Such a membrane does not ordinarily cast a very dense shadow, unless there is some previous hyperplasia. (Fig. 9A.)

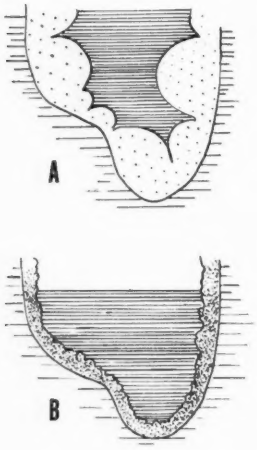

Fig. 9. Diagramatic representation of mucosal contours in contact with radiopaque. *A.* Acute infection or allergy. *B.* Hyperplasia.

A hyperplastic membrane casts a different shadow. Its submucosa is thickened rather than swollen. Its connective tissue binds it down so that the surface is pebbled rather than ballooned. This pebbling also casts an irregularly outlined shadow, but the irregularities are small, compared to the foregoing, and the whole outline parallels the underlying bone outline. The shadow cast by this membrane is relatively dense. (Fig. 9B.)

It is characteristic of a normal sinus to fill cleanly and empty cleanly; that is, the margins are sharp in both the initial and 72-hour films. Abnormal membranes frequently cause the oil shadows to take on a flecked appearance. This is usually associated with delayed emptying, but not invariably. The contrast is plainly shown in Figs. 6 and 7.

A number of articles have appeared which are of practical value. In gathering some of these for discussion, great care has been exercised to exclude those early ones which dealt with films exposed with the vertical beam. In the nature of things, these shadows were quite incapable of accurate interpretation, and gave rise to much confusion. Since the general correction of this error, there can be seen a growing uniformity of diagnostic judgment among those whose interest has survived the change.

Coates[110] considers displacement of great help in ethmoid diagnosis. He writes: "The displacement method of introduction [of radiopaque substances] * * * gives us much diagnostic information if properly carried out. * * * The method is so simple that anyone

can avail himself of it and all of the sinuses, including the frontals and maxillaries, can be sufficiently filled at one sitting for a very complete diagnosis, albeit many radiologists do not feel the need of this method for arriving at a roentgenologic diagnosis. Formerly it was of common occurrence to receive reports of extensive ethmoid disease in the absence of diagnostic clinical signs. This is less common now, due to improvements in technique, but the overlying cells in this area usually make for confusion and difficult interpretation. * * *

"Where it is difficult or impossible to place a pack with the turbinate in situ, the Proetz displacement irrigation is often most effective. It is a very simple office procedure that patients, even young children, take to readily if they once see the method demonstrated upon another individual, and they often become enthusiastic about the results obtained. Various solutions may be used, the most common being normal saline solution, one-half of one per cent ephedrine sulphate in normal saline, or, as Ridpath prefers, poppyseed oil. The method is reasonably safe, although on two occasions I have seen some middle ear inflammation develop, which may or may not have been a coincidence. Because of this I rarely use the method in acute ethmoid infections. I have a few patients who have developed the art of giving themselves their own Proetz irrigations at home."

On the subject of possible ear infection, Davis[4] says, "I have heard of a few ear infections following this treatment in acute cases but none in chronic cases." So far as I know, no middle ear infection has ever followed any treatment in my own hands, but I have been careful to avoid irrigating noses in the acute stages and have frequently referred to the possible dangers of doing so.

Special problems sometimes require deviations from the routine for their solution.

For example, Costen[11,12] reports the case of a woman who complained of constant, daily, severe headache for several years, for which in the preceding two years she had undergone two or three nasal operations with no relief. The pain was located always on the right side, in the right root of the nose, over the right eye and into the right vertex and occiput, sometimes so severe that she became nauseated. By means of displacement, it was possible to show that the right sphenoid, which had been several times operated upon, lay anteriorly and the left sphenoid lay behind it, in fact extended around and to the right of it. This condition is not infrequently encountered in skulls, but before the radiological study was made, it had not been identified in this case. Obviously the patient had a

Fig. 10. Osteoma of the left frontal sinus, discovered during an investigation of the right maxillary sinus. No attempt to introduce radiopaques into the frontal sinus, in this film.—(Courtesy Edward Mallinckrodt Institute of Radiology.)

right-sided headache from a left sphenoid. As soon as this was opened, the patient was relieved and had remained so for two and one-half years, at the time the report was made.

Some months ago a medical student was brought to me in whom an osteoma of the frontal sinus had been discovered in the course of a maxillary sinus investigation. The osteoma occupied the upper mesial corner of the sinus, and it was important to determine whether or not the internal plate was involved. The routine positions failed to show this, as the oil lay on the floor of the sinus and did not reach the tumor.

Fig. 11. Lateral view of the preceding.—(Courtesy Edward Mallinckrodt Institute of Radiology.)

To meet the special conditions of this case, the patient was laid in the exaggerated supine position after careful shrinking of the naso-frontal duct, and oil was introduced into the sinus by displacement. Without moving the patient, the film and tube were adjusted to his head and an exposure was made in this position. In this way it was definitely shown that the growth involved both the anterior and posterior plates. (Figs. 10, 11, 12.)

Kettel[119] employs both puncture and displacement. He usually prefers puncture for the maxillary sinuses, because he requires more complete filling for his interpretation than displacement affords, and because he feels that there are normal sinuses which for some reason fail to fill. For ethmoids he considers displacement indispensable.

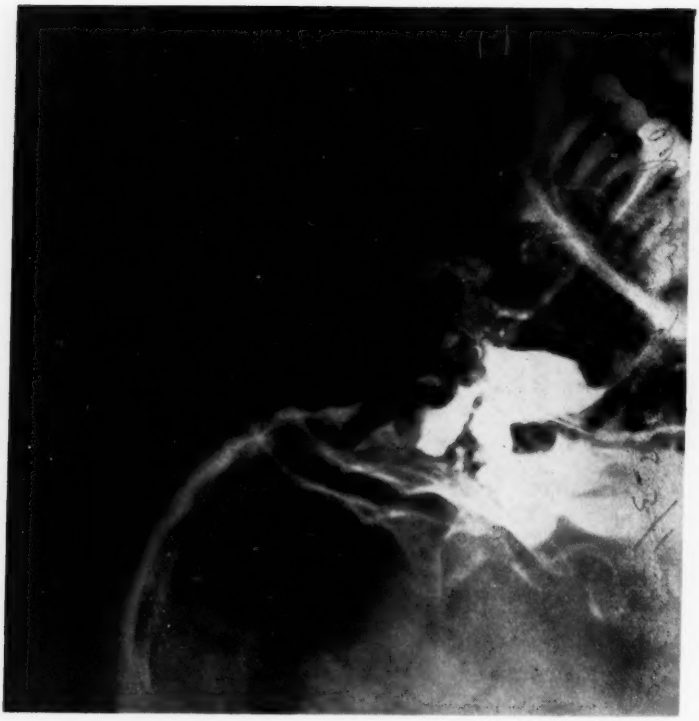

Fig. 12. Radiopaque introduced by displacement, and radiograph made with patient still supine. Position of the oil demonstates that the osteoma is attached to the internal plate.—(Courtesy Edward Mallinckrodt Institute of Radiology.)

Proby and Perron[125] call attention to the diagnostic value of filling the sinuses first without shrinking, and then shrunken. They claim in this way to be able to distinguish between obstructions arising from edema and those resulting from actual hyperplasia, degeneration of the mucosa, and other structural blockades.

McLaurin,[127] writing on the chest complications of sinus disease, makes this interesting observation: After filling the sinuses by displacement on one afternoon at 4 o'clock, the patient was told to refrain from coughing and a sedative cough mixture containing one-

fourth grain of codeine, per dose, was administered every three hours. On the following morning, radiographs of the chest failed to demonstrate any of the oil in the bronchi.

After an interval of twenty-four hours, the filling was repeated. This time the radiographs were made at once, and there was lipiodol in the bronchi, which again disappeared in twenty-four hours. The illustrations accompanying this article are instructive.

This author finds the method of value in studying the background of bronchiectasis.

Trible and Bierman[128] prefer to inject radiopaques with a cannula. They "tried [displacement] a few times, were unsuccessful, and so abandoned the method. The results with insufflation were found to be unreliable" in their hands.

Amano[105] writes: "It is not possible to expect a satisfactory result in every case since the displacement of air into sinuses may be prevented by obstructive complications. * * * The maxillary sinuses are not ordinarily successfully outlined by the administration of iodized oil by the Proetz method * * *." With this I quite agree. If it is the outlining of the maxillary sinus which is the goal of the proceeding, it will be very badly accomplished by displacement. Amano describes a knee-chest position for the patient in which the frontal sinuses may be filled to advantage. The position of the operator is not given.

Carter[108] feels that the use of radiopaques may lead to errors, and, therefore, avoids using them. His contention that the oil may completely obscure a tumor has been discussed above, but it is noted here, together with his statement that "radiopaque substances merely give a profile outline of a plane of a sinus cavity corresponding to its widest and longest diameters from a certain point of view," in order to emphasize again that such objections as these rest upon an incorrect technique. What Carter says is true, provided that an oil of too great density is used in the first instance, and that a vertical beam is used in the second. It should be pointed out that, taken in the patient-upright position with the horizontal beam, the "profile outline of a plane of a sinus cavity" compared to the identical plane of the bony cavity equals a filling defect, which is, after all, the purpose of the whole investigation.

The sudden thickening of ostensibly normal membranes as the result of allergy has been verified by Dean,[113] and extreme variation in the extent and distribution of such thickenings has been pointed

out by Beeler, Smith and Collins.[106] Their quotation from Jones to the effect that oil remaining more than forty-eight hours is pathological, leads one to caution the student that this, while possible, must apply to an oil which is much less viscous than most of those in common use. The emptying time is in inverse ratio to the viscosity of the oil, provided that the ciliary activity is the same in both cases. It is the common experience that such oils as lipiodol diluted with an equal amount of olive oil, or brominol (light) require nearly ninety-six hours to leave the normal sinus completely. Certain aqueous solutions disappear in twelve hours.

In this connection, the observations of Whitney and Doub[131] are noteworthy. These authors, examining a series of twenty cases at the end of forty-eight hours find some oil remaining in sixteen of them. Only twelve of these sixteen showed pathological changes. Among the four which emptied themselves in forty-eight hours, no filling defect was found. Unfortunately these observations were not continued beyond forty-eight hours, so that no report appears regarding the fate of those twelve pathological and four normal sinuses which retained oil. Our own experience is that a normal sinus empties itself of about one-half the contained oil in each twenty-four hours. The variations to which this rule is subject are not sufficient to invalidate it.

In extenuation of the length of this presentation and the tedious detail which has been permitted to pervade it, I can only plead that it is the most complete account which I can render of the Displacement Method as it has functioned in many hands. It is my hope that by this means it may be made to yield better results both to those who have had difficulty with it, and to those attempting it for the first time.

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NOTE: References in the text which do not appear in this list are to personal communications to the author.

1010 BEAUMONT BUILDING

Clinical Notes

LX

TUBERCULOSIS OF THE TRACHEA WITH SYPHILITIC ENDARTERITIS AND OCCLUSION OF THE LEFT SUBCLAVIAN ARTERY; REPORT OF A CASE WITH NECROPSY*

ROBERT B. LEWY, M.D.

CHICAGO

Five clinical types of tuberculosis of the trachea are recognized:

1. That associated with ulcerative pulmonary tuberculosis and combined with tuberculosis of the larynx. This is relatively common. It is characterized by superficial discrete and confluent lentile-shaped ulcerations.

2. A miliary, hematogenous infection as part of a generalized miliary tuberculosis.

3. A lymphatic spread from paratracheal lymph nodes (the subepithelial miliary tubercle).

4. That due to extension form tuberculous paratracheal lymph nodes in the presence of a silent focus in the lung. (Relatively uncommon.)

5. A primary lesion in the trachea (extremely rare).

A case with necropsy is described which demonstrates one pathogenic possibility which may occasionally, though rarely, lead to the condition designated as type 4.

REPORT OF A CASE

CASE 1.—A. H., a 33-year-old white female, was first admitted to Cook County Hospital in March of 1936, with a provisional diagnosis of toxic nodular goitre. It was learned that the patient had

*From the Department of Pathology, Cook County Hospital, R. H. Jaffe, M.D., Director; Surgical Service of Dr. R. W. McNealy and the Department of Otolaryngology.

noticed an enlargement of the thyroid for eight years, and had lost about 45 pounds in weight. During the past year she had become very nervous and had a marked weakness of the left arm. The basal metabolic rate was plus 12, plus 9 and plus 2 on three occasions. Careful examination excluded the possibility that the patient had a toxic goitre.

There was an absence of the radial and brachial pulsations in the left arm. The blood pressure in the right arm was 120/70. It was not obtainable in the left. It was thought that the patient might have a cervical rib that was compressing the subclavian artery, but x-ray studies were all negative.

Laryngeal examination on April 4, 1936, showed that both vocal cords moved normally and no tumor was seen. Operation was done the following week. An obliteration of the second portion of the subclavian artery was found. The artery seemed to be surrounded by dense connective tissue. The artery was dissected free and a segment was excised. The patient made an uneventful recovery and left the hospital after a stay of four weeks, her condition not much improved.

Four months later she returned because of marked dyspnea. This was particularly noted on lying down and after exertion. At this time it was learned that the patient's husband was being treated for tuberculosis. Physical examination revealed that the patient was having labored respiration, with wheezing and was quite cyanotic and dyspneic. The heart and lungs were essentially negative.

Diagnosis at this time was tracheal obstruction. The patient was sent to the Ear, Nose and Throat Department for bronchoscopy. A mass about the size of a marble was seen bulging into the lumen of the trachea. This was above the carina and about 30 cm. from the incisor teeth, obstructing about three-fourths of the lumen. A specimen was taken of the mass, which was thought to be an inflamed gland. Microscopic examination disclosed a fibrocaseous tuberculosis. The white blood count at this time was 2,150.

Bronchoscopy was performed again September 12, 1936. Removal of the mass by dessiccation and diathermy was suggested. A low tracheotomy was also considered. Meanwhile x-ray treatment was instituted with definite, temporary improvement. A film of the chest made at this time showed no mediastinal mass, no evidence of tuberculosis or cervical ribs. The patient's legs became edematous; she developed a low-grade fever, coughed a great deal and had much difficulty in breathing. In this condition she lingered and expired

three months after her second admission. A post-mortem blood examination revealed a four plus Wassermann and a one plus Kahn reaction.

Autopsy was done by Dr. R. H. Jaffe. The external examination disclosed a slenderly built and well-nourished white woman whose face was moderately cyanotic. Above the left clavicle there was a surgical scar 14 cm. in length. When the sternum was removed and the anterior mediastinum exposed, a very firm, dense, grayish-white scar tissue which extended to the left side of the aortic arch into the supraclavicular region was found. There was also a dense scar which followed the trachea downwards to the left main bronchus. Imbedded with this scar tissue were multiple moderately anthracotic lymph nodes which contained discrete caseous areas varying from 20 to 35 mm. in diameter. The lower half of the trachea and the two main bronchi were filled with much thick pus. In the lowermost portion of the trachea on the left side and extending for a short distance into the left main bronchus there was an irregular ulcer that measured 5 x 3 cm. in diameter. On the floor of the ulcer were exposed several cartilaginous rings of the trachea covered by yellow-gray caseous material which seemed to extend through the wall of the trachea into the sclerosed para-tracheal tissue. The lungs were much distended and crepitant throughout. In the middle third of the posterior aspect of the right lower lobe a firm subpleural nodule was found. It measured 7 mm. in diameter and consisted of a dry caseous center and a firm, deeply anthracotic capsule. On sectioning the lungs were moist light purple-gray. The heart weighed 300 grams. The myocardium was purplish-brown and moderately firm. Starting 1.5 cm. above the aortic valve and extending through the arch into the uppermost portion of the thoracic aorta, the intima was wrinkled and scarred. These changes were most marked about the openings of the left common carotid and subclavian arteries. The opening of the subclavian artery was completely obliterated and in its place a shallow 4 x 5 mm. depression was found distal to which much dense gray-white scar tissue was encountered. The spleen weighed 410 grams and was soft. The liver and kidneys were swollen, of diminished consistency and slightly congested.

MICROSCOPIC EXAMINATION

The floor of the ulcer is composed of a structureless caseous material which extends deep into the wall of the trachea. It rests upon a cellular and vascular granulation tissue with nodules of epithelioid and giant cells. Many of these nodules show central caseation. At the edge of the ulcer the mucosa is thickened and

infiltrated by round cells and histiocytes. The normal epithelium has been replaced by squamous epithelium which forms from three to five layers.

The left subclavian artery is surrounded by much very dense and sclerotic connective tissue which extends close to the media and contains only a few blood vessels with thickened walls. It often continues into the media, isolating and replacing the muscle fibers and fuses with the sclerotic tissue that has completely obliterated the lumen. The media appears as a wavy band and in localized areas there are deposits of small calcium granules which impregnate the elastic fibers as well as the muscle fibers. The internal elastic membrane is separated into several layers and often interrupted. The intima is moderately thickened and seems to fuse with a dense tissue that fills the lumen.

The diagnosis is:

Ulcerative caseous tuberculosis of the lower portion of the trachea.

Fibrocaseous tuberculosis of the paratracheal and right hilar lymph nodes, and those about the bifurcation.

Encapsulated tuberculous primary lesion of the right lower pulmonary lobe.

Acute emphysema of the lungs.

Syphilitic aortitis with occlusion of the opening of the left subclavian artery and obliterating endarteritis of this artery.

Infectious hyperplasia of the spleen.

COMMENT

In 209 cases of pulmonary tuberculosis which came to autopsy at Cook County Hospital since 1927, only sixteen showed an active tuberculosis of the paratracheal lymph nodes. Eight of these were associated with diffuse miliary tuberculosis. There were 24 additional cases of involvement of the tracheobronchial lymph nodes.

The histological picture, together with the microscopic findings, are very characteristic of an ulcerative tuberculosis of the trachea that has followed the extension of a tuberculosis of the paratracheal lymph nodes. A chain of tuberculous lymph nodes leads from the ulcerative lesion of the trachea to the well encapsulated fibrocaseous primary lesion in the right lower pulmonary lobe.

As far as the ulcerative lesion in the trachea is concerned, it is very questionable that there is any direct relation between this

lesion and the syphilitic aortitis. One may perhaps consider a syphilitic etiology of the tracheal ulcer. However, gummatous infiltrations of the trachea tend to scarring and shrinking, thus causing great deformities of the trachea. In this case the process is purely productive and caseous, and carries all the histological earmarks of a tuberculous granuloma. Furthermore, the ulcer in the trachea can be linked to an older fibrocaseous tuberculosis of the paratracheal lymph nodes, which in turn is part of a tuberculous primary complex with a primary lesion in the right lower pulmonary lobe. The marked scarring about the tuberculous lymph nodes represents residues of an intensive perifocal reaction, and it is this perifocal reaction which has fixed the lymph nodes to the trachea preparing the way for the continuation of the tuberculous process.

Two points are of clinical importance in this case. First, the diagnosis was established bronchoscopically; second, endobronchial treatment was instituted which gave temporary relief to the patient. Bilderbach and Ashley,[1] McConkey[2] and Crimm and Strayer[3] report similar cases in which they felt that bronchoscopy should have been done. Orel[4] reports two similar cases with endobronchial treatment and recovery.

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LXI

SPASMOPHEMIA IN DYSLALIA COPHOTICA: CASE REPORT

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AND

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HANOVER, N. H.

Spasmophemia, or stuttering and stammering, very frequently occurs in people with slight loss of hearing. This was first studied experimentally and reported by Waltz et. al.,[1] based on college students with blurred auditory acuity. This correlates with other studies of spasmophemiacs showing them to be weak in several aspects of perception,[2] and as a corollary, below average in coordination: less sure of themselves.[3]

In the case of dyslalia cophotica,*[4] lack of speech in deafness, the oral pupil is taught to speak by phonetic methods. This building of the speech structure piece by piece, makes them continually conscious of the articulatory movements. With such voluntary control of speech, the deaf could not stutter, according to Russell's neuropedagogic theory of spasmophemia.[5]

It is the purpose of this paper to report a case of stuttering in a congenitally and profound deaf child. Such a case is a rarity. Bluemel[6] quotes Gallaudet,† who said, "I have been engaged in teaching the deaf for more than fifty years and have visited many schools in this country and Europe. I must have met many thousands of this class of persons." Dr. Gallaudet continues to say, "I have never known a congenitally deaf person who stammered or stuttered."

Speech therapy as a science owes its principal development to Albert Gutzmann of the University of Berlin. His son says,[7] "It is well known that the congenitally deaf never stammer—and in Germany, at least, they are all taught by the oral method and gain a

*This term dyslalia cophotica is the new term for the old dyslalia cophica.

†For whom the college for the deaf, Gallaudet College, Washington, D. C., was named. He was president of the Columbia Institution for the Deaf and Dumb, Washington, D. C.

thorough mastery of speech. The reason for this is manifest. In the first place, they learn speech under the constant supervision of an instructor; and in the second place, they learn to associate ideas with words only as they slowly and progressively acquire mastery of the articulative organs. The objection—which has been made—that there are stammering children in institutions for deafmutes does not affect the validity of the statement, for it is certain that these children are only hard of hearing or that they have become deaf only after normal speech has been acquired. For my part, I have never met a stammering child in a school for deafmutes; but I do not disavow the possibility of their existence, which is reasonable enough from the above point of view."* This statement has added weight when it is recalled that the Teutonic races are more prone to develop spasmophemiad speech than some other nationalities.[8] This above quotation has been repeated by the grandson in the latest edition of the book.[9]

Even though the Gutzmanns and Dr. Gallaudet have never seen any deaf child stutter, a case has been now mentioned in the literature.[10] This patient might or might not be congenitally deaf. There is no mention in the paper as to the onset of deafness. The stuttering, however was examined also by other speech therapists, who agreed that it was a real case of spasmophemia.† Miller Shaw describes this case as follows: "Case No. 7, a boy 21 years old, with a hearing loss of 47 per cent, presented the most unintelligible speech in the whole group. His voice, extremely nasal, had some pitch changes. His rhythm was very broken. His speech was cluttered. He spoke, or attempted to speak, frequently on the inspiration—after which there was a tonic bloc, as in a stutterer. He seemed to try to take in too much air on each inspiration. In addition to very imperfect *s* and *z* sounds he substituted an imperfect [s] for [z], an imperfect [ts] for [dz], *p* for *b*, *t* for *d* (*nt* for final *d*), *k* for *g*, *f* for *v*, and an approximation of a *d* sound for the *th* sounds. For [y] he used either *n* or [n e]. Many vowels were nasalized. The front vowels, particularly *i*, were most nasal. The reversal of sounds in the word, common to all the cases, was more prevalent in this speech than in any of the others. This boy has a large basal spur on the right side of the nose, which of course causes obstruction, but one of the cases presenting the best voice quality had these same spurs on both sides of the nose, in addition to a very irregular septum. So one cannot be sure that the bad voice quality is due to this abnormality. This patient has also a high palatal arch. The larynx is normal. He complains of "scratchiness" in his throat and "confusion" in his ears (I use his terminology), very

*The translation is that of Bluemel, supra, p. 234.

†L. E. Travis of the Psychiatric Hospital, Iowa City, et al.

soon in the training periods. Although some of the sound formalities have been corrected, his speech in general seems to have improved only slightly, if at all." The description of the case has been quoted in full so that as complete a picture as possible might here be restated. The report placed no emphasis on the finding of a deaf person who stuttered.*

The case reported in this paper is of a congenitally deaf person with secondary spasmophemia. Although this paper is presented for those who will consider the case in the light of its influence on spasmophemiad theory, it is well to call attention to its significance concerning the development of diagnostic pedagogy for the deaf. It would certainly indicate that the deaf do gain speech facility, sufficient to make utterance an involuntary action. It can not be intimated, however, that this case was glib in all speech, but it can be stated that in parts of his speech and in that part of his phonetic utterance where he stuttered, he did have facility. This was demonstrated clinically.

REPORT OF A CASE

CASE 1.—The patient's parents were Catholics, of Austrian stock, and were very co-operative. They were a hard working family and believed in disciplining their children. The boy was about the middle child of a slightly large family. He had an older sister, who was congenitally deaf, but quite intelligent. His was what would generally be called a good family background.

Psychologic Examination.—He was a sensitive, lovable boy and not at all a discipline problem. He was bashful and very nervous, and seemed to have feelings of inferiority. He never showed off. He flushed easily, was nervous before the class and not self-confident. He was shy and worked independently. Although he was prone to embarrassment, he could make rapid decisions. He did, however, play with the group and was well liked by his playmates. His feelings were easily hurt, especially by criticism. He worried over misfortunes. He was the day-dreamer type, had blonde complexion and blue eyes. His anthropometric measurements were above average. He was well nourished, as demonstrated by skin texture rather than height-weight ratio, and was superior in intelligence.

School History.—He was studious and industrious, was good in language work and arithmetic, and his memory span was good. He made superior grades. He was not good in handwork. His handwriting was cramped and difficult; he wrote right handed.

Hearing Examination.—Congenitally and profoundly deaf, he was tested by a physician as early as two years of age because he did not start to talk. At ten he entered a deaf school where his hearing could be tested accurately with Western Electric audiometers. It is impossible to be certain of test results before eight

*The symbols are those of the International Phonetic Association. See Le Maitre Phonétique.

years of age because of a lack of clinical tests. His hearing acuity curve was typical of the congenitally deaf. The etiology was unknown.

Speech Examination.—The important factor is that he had never heard speech, even with an audiophone. He of course had delayed speech (paralalia prolongata). All his speech was taught by the phonetic approach. Examined at twelve years of age, his speech was rapid and hurried and not very clear-cut. His voice was husky, hoarse, breathy (pneumophonia), and thick (gutterophonia). He always volunteered to recite. His articulation had the typical general defects frequently found in oral deaf pupils (dyslalia cophotica). Frequently he spoke on inspiration. He could easily be diagnosed as a case of secondary stuttering (spasmophemia). He had the typical shallow, irregular breathing and "breath-catch" tonic stuttering (phanerogenic spasmophemia). His spasmophemia blocks occurred at the beginning of sentences and were more frequent on voluntary recitation than on answering. His was diagnosed as a case of dyslalia cophotica with the complication spasmophemia.[11]

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The Scientific Papers of the American Bronchoscopic Society

LXII

PRESIDENT'S ADDRESS*

JOSEPH C. BECK, M.D.

CHICAGO

I think before I begin, not an address but a few remarks that I wish to make, I want to tell this Association that I will have to leave the meeting immediately after these remarks. The American Board has a very important meeting this afternoon and I must attend. Dr. Kernan, the Vice-President, has kindly consented to take care of the meeting for the rest of the afternoon session.

I have not prepared an address, but I wish to express again my appreciation for the honor bestowed upon me by being selected as your President. I feel it is a great honor to be placed in the position of President of this Association.

I thought that perhaps I could read the minds of most of you and that there might be something I could say that would be of benefit to the bronchoscopist. In the first place it would be reminiscing of the olden days of removal of foreign bodies from the air and food passages and then through this bronchoscopic age, where I have been very fortunate indeed in seeing the development of this special field of otolaryngology reach the perfection that it has.

I have been in practice long enough to have seen some of the horrible examples of attempts at removal of foreign bodies, both in the air passages and the esophagus, and then awed at the marked change when the scopes came into being.

Historically speaking, in times past, I have seen many, many attempts at removal of foreign bodies and many clever things were done before the era of the x-ray, bronchoscope and esophagoscope.

*Read before the Twentieth Annual Meeting of the American Bronchoscopic Society at Atlantic City, June 2, 1937.

Only a year ago I was presented with an instrument by a friend of mine, Dr. Henry Hitz, of Milwaukee, who was successful in removing a marble from the esophagus of a child by means of an instrument which he constructed himself. This was thirty-two years ago and I show it as evidence of many of the little tricks physicians had to resort to.

However, we were not always so successful. I have seen quite a number of esophagi punctured with complicating mediastinal infection and death, as well as pneumonia and lung abscesses. Operations on the mediastinum and pneumonectomies were rarely performed and if they were you know what the outcome would be.

My first introduction to bronchoscopy was reading German articles by Kierstein and Killian, but my real appreciation of this field was when the late Doctor William Ballenger and I made a trip to Pittsburgh to visit Dr. Chevalier Jackson. We were there for three days and had a grand time doing bronchoscopy on dog and man cadavers—our first lessons.

In due time I returned to Chicago where I had a service at the Cook County Hospital in conjunction with Dr. Stanton Friedberg, who later became a real bronchoscopist. We were waiting for our first foreign body case. It wasn't long before little Joe Cleary, a seven year old boy, came in with a miniature toy incandescent lamp in his main right bronchus. It was x-rayed and showed the foreign body to be in the right bronchus, consequently we started immediately, Dr. Friedberg assisting me. Remember this was the first attempt at removal of a foreign body with a bronchoscope at the Cook County Hospital. After working under general anesthesia for about an hour, with Jackson's latest instruments, which were kindly loaned us by V. Mueller and Company, we had to give up for fear we would get a great deal of trauma of the larynx, followed by edema and would have to do a tracheotomy. Stanton Friedberg and I remained at the hospital over night, and I assure you that that was the first and only time I stayed in the hospital all night during the eighteen years I had been on service. We stayed because we wanted to be sure if a tracheotomy became necessary the patient would be given the very best service. At 2:30 a. m. we had to perform a tracheotomy, following which little Joe recovered in two or three days. We then proceeded through the tracheal opening, again putting the child to sleep, and, lo and behold, what a sight it was to see that foreign body. It appeared about three or four inches from the tracheal opening and I was about to grasp it when the child awakened sufficiently to cough and I felt something strike my forehead and

bounce off onto the floor. The little patient was left to himself while we looked for the lamp on the floor, as this was our prize exhibit. (Laughter.)

This, then, was the first and only foreign body case, in which removal was attempted bronchoscopically, that I have had in my experience. I want you to know that now.

A short time after the case just described, another case came into the Cook County Hospital, namely, a quarter in the esophagus. Joe Lichtenberg was the name of the patient. That was another Joe. These Joes come in threes. Joe Lichtenberg was a boy about twelve years old, and the quarter in his esophagus was nicely shown in the x-ray, as being located just at the cricoid cartilage. We proceeded again, with a good galaxy of attendants, visitors, etc., this being the first foreign body removed from the esophagus in the Cook County Hospital. Dr. Friedberg again assisted me, but this time we were much more successful.

The quarter in the esophagus was promptly removed and I was getting a hand from the crowd when a gentleman came up and made a lunge for the quarter. It was the father of the child. (Laughter.) I said, "No, you can't have that as it is my specimen. I am going to show this to many doctors to let them know I was successful in removing the quarter from your child." Whereupon he said, "This came out of my boy and it is my quarter." I asked him if another quarter wouldn't do as well and he said it would. These, then, were my two foreign body cases which I have had in my experience, although I have had many cases referred to me, and I, in turn, have referred them to my bronchoscopist confreres. To be sure I have employed the bronchoscope and esophagoscope very much in diagnoses and treatment of neoplasms in this area.

Then and there I made a bargain with Stanton Friedberg, namely, that I would give him all foreign body cases at the Cook County Hospital, as well as in private practice, if he would give me all of his neoplasms. This went on for a number of years at the Cook County Hospital, and Stanton Friedberg did all of the foreign body work. However, I retained my interest in bronchoscopy and esophagoscopy in relation to other diseases.

The next point I wish to call to your attention in reminiscing, is my observations of this Society during the earlier years, attending, I think, quite faithfully and taking interest in the work. At this time I wish to record my observations of some of the men who have been doing this work from the very beginning. Some of them were

very young men when we lost them and it was a great loss to bronchoscopy. Drs. Henry Lynah, Stanton Friedberg, Sidney Yankauer, Campbell Smyth, Clyde Lynch and Edward McGinnis are the outstanding men of the founders that have gone to the Great Beyond. It struck me that Stanton Friedberg was my greatest loss. These men were taken away when they were at their very best in this work. Those of the founders who lived and are living now certainly have shown us great progress in this field and I am sorry that I have not and cannot add anything, except to say again that I appreciate having been privileged to be a member all this time, and, as I said before, having been honored by you as selecting me as your president.

I had a thought in mind regarding the future membership of the Society and I believe if I read you a brief correspondence between Dr. Chevalier Jackson and myself, it would best bring out the points I wish to make.

"My dear Chevalier:—

"At the council meeting of the American Bronchoscopic Society, I told the men, as well as Dr. Patterson, I wanted to present in my brief address certain pertinent and maybe impertinent views and I wanted their opinion, but all they would say was, 'Whatever you say will be O. K.' Now I would like to have your opinion and I will state these points very briefly:

"1. I believe that every certified otolaryngologist must have a fair knowledge, as well as some experience, in the application of bronchoscopy and esophagoscopy.

"2. I believe that every larger city in the United States, say, 50,000 or over, should have sufficient number of bronchoscopists that have had special training to be known as such in accepted, well regulated hospitals. In other words, in every hospital there should be one otolaryngologist particularly designated and recognized bronchoscopist who is not necessarily limiting his work in that field.

"3. That in every larger center, such as Chicago, St. Louis, Denver, Los Angeles, and San Francisco, as well as the larger cities in the East, North and South, there should be at least one man or woman who is limiting his or her work to bronchoscopy and esophagoscopy. These physicians, however, should be encouraged to do some borderline work such as laryngeal surgery, chest surgery, or both.

"I am sure you have expressed yourself along these lines many times, but unfortunately, I have never heard you. If you think I had better chuck this whole thing, please don't hesitate to say so,

for all I wish to do is propose something that may be an advancement in this field of our specialty.

"We are very fortunate indeed in Chicago that we have such a man who limits his work to bronchoscopy and its borderline and I feel he should be encouraged and supported.

"Anticipating an early reply, I am

Yours truly,
Joe Beck."

Dr. Jackson's reply was as follows:

"My dear Joseph:—

"I heartily agree with everything you have formulated and I am glad someone—(I hesitate to read this) of your high standing in medicine, as well as in otolaryngology, will present this matter. It is really very important that it be presented.

Yours truly,
Chevalier."

Three slides were shown of the three places and equipment used by Dr. Paul Hollinger, the bronchoscopist limiting his work to this field and referred to above.

1. St. Luke's Hospital.
2. Children's Memorial Hospital.
3. University Research Hospital.

As I told you in the beginning, Dr. Kernan was kind enough to preside for me during the afternoon session, and Mrs. Beck and I will be glad to see you for cocktails before the dinner of the Society. I shall be happy to preside at the evening session.

185 North Wabash Ave.

LXIII

COCAIN SENSITIVITY IN BRONCHOSCOPY: CASE REPORT*

DAVID H. JONES, M.D.

NEW YORK

There is very little written in the literature regarding anesthesia of the bronchial tract for bronchoscopy.

Cocain in varying strengths, which should be colored differently, has been the drug of choice in many hospitals. Some surgeons are now using larocain or nupercain. It is a well known fact that when cocain is applied to the mucous membrane it has a local vasoconstrictor action and is absorbed rapidly. Then the systemic and toxic effects start and we should use all methods in our power to delay its absorption by restricting the local circulation. Gehse states that the addition of phenol and adrenalin chloride to cocain increases its efficiency from five to ten times and reduces its toxicity to a minimum.

Patients of a neurotic type should be given extra thought, as the nervous dread of an operation creates more fear and anxiety than the actual pain experienced at the time of operation. Much of this psychic fear can be controlled by giving some form of the barbiturates, as brought out by Leshure in 1927, and it was considered an antidote for cocain.

Against this theory is an article in the March (1936) number of the Canadian Medical Association Journal by F. H. Wetmore, who quotes Sir William Wilcox in an address before the Royal Society of Medicine, who stated that all forms of barbiturates were harmful, some people being very susceptible, especially allergic types, asthmatics and those with defective renal and liver conditions. And he was positive that pneumonia often results after the administration of barbiturates.

Notwithstanding this adverse report, I still feel that the administration of one capsule of nembutol the night before and one capsule at 9:00 a. m. on the day of operation, and one hour prior to the operation the administration of a hypodermic of ¼ gr. or 1 6 gr.

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*Read before the Twentieth Annual Meeting of the American Bronchoscopic Society at Atlantic City, June 2, 1937.

of morphin, combined with 1 300 gr. hyoscin, banishes all fear and dread of the operation.

REPORT OF CASES

Case 1.—I. G., female, age 26, came to Manhattan Eye, Ear and Throat Hospital, on the service of Dr. Charles Imperatori, with a history of daily recurring hemorrhages. At the first bronchoscopy, November 30, 1931, nothing was seen to account for the hemorrhages and it was suggested that instillation of lipiodol be done, which was performed using the same technic on December 9th, December 18th, 1931, and on January 8, 1932.

On February 26, 1932, she entered the hospital for her fifth bronchoscopy and told the nurse that she had a peculiar feeling of numbness on the right side of the head and also a slight headache. At 1:30 p. m. she was given ¼ gr. of morphin hypodermically, and when placed on the operating table seemed to be under the influence of the morphin to a greater degree than before. Two applications of 10 per cent cocain were sprayed into her throat. No laryngeal applications were used; on introduction of the laryngoscope slight difficulty was encountered, and at that time 2 cc. of 4 per cent cocain was sprayed into the trachea and bronchi. Nothing abnormal was seen. Five cc. of lipiodol was instilled into each lung. Operating time, five minutes.

Patient was then taken to the x-ray department on another floor and immediately had a general convulsion, in two minutes another, followed by two more. All methods of resuscitation and stimulation were tried for one hour with no result.

Autopsy, performed by Dr. Thomas A. Gonzales, showed no injury or any abnormality in lungs, esophagus or viscera. On removing the skull cap, meninges showed considerable milkiness, some thickening and moderate edema of brain; on section, no lesion except engorgement of the choroid plexus, considerable flattening of the cortical convolutions and one small hemorrhage underneath the arachnoid on the under surface of the front portion of the occipital lobe. Portions of the brain, the liver and the kidneys were sent for chemical examination. Cause of death: Chronic leptomeningitis, general visceral congestion pending chemical examination. On July 28, 1932, a letter was received from Dr. Charles Norris, Chief Medical Examiner, which states that chemical examination of the brain, liver and kidneys, all general unknown poisons absent and cocain could not be detected.

Case 2.—D. R., female, age 28, after an attack of influenza in 1932, had repeated hemoptysis. Numerous x-rays of the chest and

sputum examinations were negative for tuberculosis. On November 26, 1934, one tablet of amytal was given at 8:00 and 10:00 p. m., and another at 10 a. m., November 27, 1934. At 12:15 p. m. morphin sulphate, grs. 1/6, and hyoscin hydrobromide, grs. 1/300, given by hypo. At 1:15 p. m. cocain spray 10 per cent and local applications in pyroform fossa. The bronchoscope was then introduced and cocain, 10 per cent, was sprayed into the bronchi. Patient immediately developed twitching on the right side of the face and clonic movements of the right arm, which was followed by general convulsions of the whole body lasting from three to four minutes. Resuscitation used and patient regained consciousness and recovered.

After these two very vivid experiences I have been very careful in the use of cocain. For the past two years I have used Forestier's Solution in all laryngoscopies and bronchoscopies, preceded by the preliminary medication, as mentioned in the early part of this report, and have never heard a patient complain of faintness or any disagreeable symptom.

FORESTIER'S SOLUTION

Cocaine hydrochloride	2.00
Phenol	.20
Adrenalin chloride (1-1000)	10.00
Aqua lauro cerasi	40.00
Aqua destillata qs ad	150.00

Forestier's Solution can be dropped into one nostril, 2 cc. every five minutes, until four doses have been given, traction being made on the tongue, lifting up the epiglottis, or it may be dropped into the larynx with a laryngeal syringe. I feel that if this method is given a trial one will obtain almost perfect anesthesia with no fear of cocain poison.

Of course, it is not necessary to perform a bronchoscopy for the instillation of lipiodol, as it can now be done either through the nose or by the intratracheal catheter method.

140 EAST 54TH STREET.

LXIV

MULTIPLE PAPILLOMA OF THE ESOPHAGUS: CASE REPORT*

WESTLEY M. HUNT, M.D.

NEW YORK

There have been reported comparatively few cases of papilloma of the esophagus. This condition no doubt is more frequent than the medical literature would indicate. The symptoms are at a half-way stage between an irritated esophagus and a condition due to definite cardiospasm, stricture or malignancy, which might bring the case to the endoscopists for their aid and diagnosis. It seems likely that papilloma of the trachea or bronchi would be observed by the endoscopist earlier than those of the esophagus because of the more distressing symptoms.

The more the internist becomes educated to the value of esophagoscopy in the milder cases of esophageal disturbance the more cases of benign tumors of the esophagus will be reported.

The case which I now report is concerning a woman, 70 years of age, who first came under my care in 1931. She comes of a cultured family and background. She is of a highly nervous nature, has had stomach trouble for the past thirty years and has been under the care of many physicians here and abroad. Thirty years ago she was taught to pass a stomach tube and to do a stomach lavage. This she did daily for twenty-two years, until eight years ago her esophagus became so ulcerated that she had to resort to a smaller tube, through which she was able daily to drain quantities of bile. She also became very efficient at passing her own bougie for dilatation, which she did two or three times a week. In fact, she became a most efficient sword swallower.

When she came under my care, in 1931, she complained of pain in her stomach, a burning sensation in her esophagus and pain in the region of her right shoulder. She expectorated blood after using her tube and could eat no coarse food. The x-rays of her esophagus with barium were negative except for a slight evidence of retention at the cardia. She weighed 165 pounds, which was normal for her.

*Read before the Twentieth Annual Meeting of the American Bronchoscopic Society, Atlantic City, June 2, 1937.

At this time a possible malignancy was suspected, but an esophagoscopy revealed an ulcerated lower esophagus, some varicosities and a moderately tight cardia; the upper end of the esophagus appeared normal. A specimen was removed which was not malignant. The following year, 1932, a second esophagoscopy was done with the same finding, although showing an improvement during the year of the ulcerative areas. She continued medical treatments; diet, self drainage of the stomach and self dilatation with little change in comfort. She gradually lost weight from 165 pounds in 1931 to 130 pounds in 1936, although in no way emaciated.

Her gall bladder being under suspicion, in 1936, she had sixty-five x-rays of her whole body and a thorough medical check-up which failed to reveal any pathology. The x-rays of her esophagus were quite normal, as were her blood count, Wassermann test and blood chemistry.

An esophagoscopy was done in 1936, at which time there appeared multiple small tumors just above the cardia and just below the cricopharyngeus. A biopsy showed these to be papillomata.

She has no papilloma of the nose, throat or larynx. She still has the same pain and difficulty in swallowing. She is able to take only fluids and well ground food; she still passes her small tube, which is followed by occasional bleeding and complains of repeated regurgitation of food. She has more pronounced pain four hours after eating and takes considerable codein to control it; she takes atropin for the esophageal spasms; she eats better standing up and maintains fair weight and health except for her continuous discomfort in eating, pain and nausea.

This case is interesting because of its rarity, the importance of esophagoscopy in diagnosis, the continuous daily trauma over a period of thirty years, the apparent origin of the papillomata at the lower end of the esophagus and the possible transplantation at the upper end by the continuous tube passing.

33 East 68th St.

LXV

TUBERCULOMA OF THE BRONCHUS: REPORT OF A CASE*

ROBERT L. MOORHEAD, M.D.

BROOKLYN

CASE 1. C. C., aged 17 months. Referred October 30, 1934.

Four weeks ago a wheezing was noticed which has continued up to the present, and although continuous, is worse at night. It does not change with change in position. There has been a slight cough, not paroxysmal, and no cyanosis. Shortly after the onset of the wheezing the child had what appeared to be an acute respiratory infection with fever and cough, but this lasted only a few days. There is no recollection of the child having swallowed anything unusual.

On examination the child did not appear acutely ill, its color and nutrition were very good and there was no respiratory distress. There were no changes in the percussion note, but there were diminished breath sounds over the entire right chest with a few crackling rales heard anteriorly. The heart was normal. Blood count, R. B. C., 4,400,000; Hbg,. 88 per cent; leucocytes, 10,900, with 70 per cent lymphocytes.

X-ray examination of the chest, made October 24th and 29th, showed a relative emphysema of the right lung with some displacement of the heart and mediastinum to the left.

A diagnosis of probable foreign body in the right bronchus was made and the child was referred for this condition.

Bronchoscopy was done October 31st, without anesthesia, with a 4 mm. tube. On entering the right bronchus a mass of granulations was found occluding the entire lumen. Removal of these with forceps was accomplished without bleeding and the bronchus was then seen to be practically normal. It was noted that these granulations were coming from a small area above the orifice of the upper lobe bronchus and the opening was situated on the anterior lateral wall.

Microscopic report: Specimen composed of an edematous cellular connective tissue which is heavily infiltrated with round cells

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and polymorphonuclear leucocytes. Several circumscribed minute nodules of pale epithelioid cells are found. Caseation is not present.

Diagnosis: Tuberculous granulation tissue.

Following the bronchoscopy the child remained well until one month later, when practically the entire picture reappeared, although in the meantime the child had gained one and one-half pounds in weight.

Bronchoscopy was again performed on November 30th and the bronchus cleared of the obstructing mass of tissue. Following this four deep x-ray treatments were given, which apparently arrested the disease, and there have been no further evidences of recurrence. It is now two and a half years since the last bronchoscopy and the child has been perfectly well.

COMMENT

Although tuberculosis of the bronchus is not especially rare, it is unusual in a child of only seventeen months. From the location and character of the bronchial lesion it seems probable that the process was caused by a tuberculous gland which had eroded the wall of the bronchus. At the second bronchoscopy it was noted that the lesion extended through the wall of the bronchus, although no attempt was made to probe this tract.

CASE 2.—Patient male, age 26 years. Admitted October 19, 1934.

For the last six months has noticed some difficulty in swallowing solids so that at present his diet consists only of liquids and semi-solids. The obstruction was referred to the upper esophagus and there never was any regurgitation. One week ago he had been esophagoscoped at another institution, and a few hours later noticed severe pain in the neck, followed by fever, weakness and extreme dysphagia.

On admission the patient appeared to be acutely ill, with a temperature of 104, pulse 140, tongue very heavily coated, inability to swallow anything except the smallest amount of liquids. The neck was swollen, indurated and very tender, all of which was more marked on the right side.

X-ray films taken showed a large abscess cavity in the neck, containing considerable air, and the fluid in this cavity showed a well marked fluid level, which changed with any change in position

of the neck. An incision was made along the anterior margin of the right sternomastoid muscle and the abscess entered by blunt dissection. The air escaped with a loud whistling sound that could be heard across the room. The cavity was drained by a rubber tube. Recovery was uneventful and he was discharged from the hospital on November 12th.

X-ray studies before he left the hospital showed no difficulty in the passage of barium, but in spite of all arguments he refused to allow us to make a direct examination of the esophagus.

125 Remsen St.

LXVI

RETENTION CYST OF THE LARYNX: REPORT OF A CASE*

MURDOCK EQUEN, M.D.

ATLANTA

Cysts of the larynx are unusual; many experienced laryngologists have never seen one. In his new book, however, Chevalier Jackson reports sixty-one cases. The ages of his patients varied from a few hours to seventy-five years. There was no appreciable difference in the sex incidence. By far the most frequent site of origin is the epiglottis, and then in order of frequency come the vocal cords, the ventricular bands, the arytenoids, the aryepiglottic folds and the pyriform sinuses. Jackson classifies these cysts as follows:

1. The glandular cyst, or cystic adenoma.
2. The connective tissue or retention cyst.
3. The pseudocyst, or dilated glandular acinus.

In the present case of a pedunculated connective tissue or retention cyst arising from the posterior surface of the cricoid there are certain bizarre features of profound interest.

REPORT OF CASE

A clergyman of thirty-five for several months had been annoyed with difficulty in preaching. When he would reach the climax of a sermon and his voice was raised with emotional fervor he would suddenly lose his voice entirely and become short of breath. When he sat down and took a swallow of water he had the sensation of swallowing something solid with the water; then he could talk again and was free of dyspnea.

Indirect examination in another city had at times revealed the presence of a mass about the size of a pecan, while at other times nothing abnormal was found. When first examined by me with a mirror repeated efforts, such as causing him to gag or to emit high tones, failed entirely to demonstrate any abnormality. It was only on direct laryngoscopic examination that the tumor was visible. The tumor was a freely movable, pale pink, ovoid mass about 2 cm. in

*Read before the Twentieth Annual Meeting of the American Bronchoscopic Society, Atlantic City, June 2, 1937.

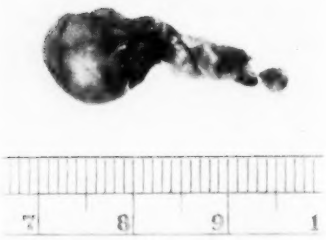

Fig. 1

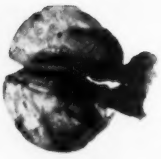

Fig. 2

diameter. Further examination revealed that it was attached through a thin pedicle to the posterior surface of the right cricoid.

The following day with the patient's head suspended in the Lynch apparatus, under direct vision, the tumor was grasped and pulled forward. With a Bard-Parker blade mounted on a long handle, which has been previously described in detail, the pedicle was severed at its base. Bleeding was controlled by the application of epinephrin and silver nitrate stick.

The specimen consisted of an ovoid cyst 2 cm. in diameter attached to a pedicle 2.5 cm. long. The cyst was filled with thick creamy material, containing bacteria such as are commonly found in the mouth.

The cyst wall was made up of vascular connective tissue, covered and lined with epithelium. The pedicle also consisted of vascular connective tissue covered with epithelium. At one place in the pedicle the connective tissue seemed to be deeply invaded by surface epithe-

lium with hyperchromatic cell nuclei. There was no other evidence of hyperplasia, and in the opinion of the pathologist, Dr. R. S. Leadingham, this was only reaction to irritation. The diagnosis was retention cyst.

The patient was able to leave the hospital on the third day and he has now been at work free of symptoms for about six months.

COMMENT

Pedunculated retention cysts arising from the posterior surface of the cricoid are rare; they may give rise to symptoms which, though inconstant, will disable a person who makes his living with his voice.

A history of sudden loss of voice at moments of emotional fervor could easily have been mistaken for an hysterical aphonia, especially when indirect examination of the larynx was found negative. The case serves to illustrate again, therefore, as Dr. Jackson has so often insisted, that we should take seriously our patients' complaints, no matter how extraordinary they sound. In this case, by a simple operative procedure, an ambitious young clergyman was completely relieved of an occupational disability.

PONCE DE LEON EYE AND EAR INFIRMARY.

REFERENCE

Jackson, Chevalier, and Jackson, C. L.: Diseases of the Larynx. Philadelphia, W. B. Saunders Company, p. 345, 1937.

LXVII

SOME INTERESTING ENDOSCOPIC CASES*

T. E. Carmody, M.D.

Denver, Colorado

Cases of endoscopy, which twenty to twenty-five years ago would have been most unusual, are no longer uncommon. However, those of us who are doing otolaryngology, with endoscopy only incidentally, may not see a variety of cases. Those coming to us may present greater problems than the more complicated cases of the limiting endoscopist.

Papers relating to endoscopic procedures have increased almost a hundredfold during the last twenty years. In March, 1936, thirty-three papers were published on bronchoscopy, esophagoscopy and the treatment of pathological conditions by the use of the armament. These articles did not include cases of laryngeal manipulation and tracheotomy.

Early publications and papers before this Society dealt almost exclusively with foreign bodies, while of the thirteen addresses and papers presented before this 1937 meeting, only one deals directly with foreign bodies as such.

Dr. Jackson's original work, and that on which he based his ideas for his first instruments, was the removal of foreign bodies. Today work in his clinic consists of only about 2 per cent foreign-body cases, while diagnostic and other endoscopic procedures are greatly increased in number.

The cases reported in this paper are not consecutive, but are reviewed because they seem unusual in some way.

Although Dr. Jackson has reported much about the peanut as a dangerous occupant of the bronchi, my experience with it has not been so unfavorable. My troubles have been much greater with grains of corn, for these have generally been loose in the trachea and have caused such injury to the subglottic tissue as to require tracheotomy either before or after removal of the kernel.

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*Presented before the Twentieth Annual Meeting of the American Bronchoscopic Society at Atlantic City, June 2, 1937.

REPORT OF CASES

CASE 1.—January 17, 1934. Girl, aged 3, came from a neighboring state with the history of having aspirated a grain of corn twenty-four hours previously. This was removed without difficulty but required tracheotomy five hours later. Recovery otherwise was uneventful.

CASE 2.—February 23, 1935. Mrs. M. referred from a small town in the mountains was seen in the office and gave a history of having swallowed a fishbone twenty-two hours previously. X-ray showed barium capsule opposite bronchial crossing. As her husband was not suffering, he insisted on taking the patient home, only to return two days later. On being called to the hospital I found the patient suffering much pain and perforation was feared. The bone was removed without difficulty and was found to be rather small with a marrow cavity similar to the small leg bone of a bird. Patient was given 25 per cent glucose by mouth for twenty-four hours before other food was allowed and showed no evidence of perforation, although there had been considerable bleeding at the time of removal.

CASE 3.—February 9, 1937. J. S., aged 46, a workman for the city water department, while eating a venison dinner was suddenly called to the phone, and, in responding, swallowed a large piece of meat with bone attached. This stopped just below the cricoid constriction. X-ray examination using barium capsule revealed the location. It was removed without difficulty but the patient complained of some soreness and difficulty in moving his head for several days.

CASE 4.—March 9, 1937. L. K., female child, aged 5, gave the history of "swallowing" a safety pin forty hours previously. The pin was located in the right main bronchus by x-ray and removed. This pin, as shown in the slide, had lost its keeper, so that it presented one sharp and one slightly dull point, both of which were imbedded in the bronchial mucosa. This increased the difficulty of removal over the ordinary safety pin.

CASE 5.—March 27, 1937. F. R., female child, aged 4½ years, had a history of having swallowed a tack two weeks previously. An x-ray of the abdomen showed a tack, which was later passed. The patient then said she had swallowed two tacks, and because of difficult breathing was referred to another clinic. X-ray located the second tack in the right side of the chest. Attempt at removal was unsuccessful and the child was referred to us. On entering the Children's Hospital the patient was having difficulty in breathing but no cyanosis. She was kept at rest for four hours, during which time she

grew gradually worse and tracheotomy was done. Three days later patient was bronchoscoped but the tack was not located. Twenty-four days later the tack was removed by lower bronchoscope with the aid of the fluoroscope. As we do not have a biplane fluoroscope in our hospital we resorted to turning the patient in order to get both planes.

CASE 6.—April 27, 1937. D. J., boy, aged 7, was playing with a thumbtack which was pushed back in the pharynx by two older boys. There was great difficulty in swallowing. The tack was found by x-ray opposite the fifth cervical vertebra. In attempting removal without anesthetic, the tack was displaced, but on introducing a small Mosher esophagoscope it was removed at cardia. The patient had no difficulty in swallowing for twenty-four hours, then for the next thirty-six hours he refused to eat and an examination revealed a bulging of the posterior wall of the pharynx. The x-ray showed an abscess in the pharynx. This was opened and the patient did nicely for forty-eight hours, when it was necessary to reopen the abscess. Following this recovery was uneventful.

806 METROPOLITAN BLDG.

LXVIII

TUBERCULOSIS OF THE TRACHEA AND MAIN BRONCHI*

JOHN DEVEREUX KERNAN, M.D.

NEW YORK

Tuberculosis of the trachea and main bronchi as a clinical subject has only comparatively recently appeared in the literature. For a long time there were only reports of autopsy material. Since the introduction and common use of bronchoscopy it has been recognized during life. This explains the varying statements as to its frequency. Myerson,[1] in 1928, reporting a case of tuberculous ulceration of the bronchus in lung abscess following tonsillectomy, stated that the condition was rare. Bugher,[2] writing in the American Journal of the Medical Sciences in April of this year, stated that in 122 cases of pulmonary tuberculosis studied at autopsy, 41 per cent showed lesions of the trachea, main bronchi or both. As bronchoscopic examination becomes more frequent, the condition is found more and more frequently during life. Epstein and Ornstein,[3] reporting on the bronchoscopic examination of 150 cases of tuberculosis at the Sea View Hospital, wrote a very comprehensive paper on this subject in 1936. They pointed out that very little emphasis had been placed on tuberculosis of the trachea and main bronchi as a complication of chronic pulmonary tuberculosis and that the reason for this was no doubt failure to recognize the condition during life.

As to pathogenesis, ideas vary somewhat. Reiche and Frost[4] consider that the most frequent mode of origin is by contiguity. The lymphatics surrounding the major bronchi and trachea and the mediastinum absorb infectious material in the periphery of the lung. In the mediastinum they are in close contact with the mucus glands lying in the walls of the trachea and bronchi outside the cartilages. Owing to this close contact of glands and diseased lymphatics, the glands are frequently attacked and carry infectious material through the walls of the bronchi into the mucous membrane. By continuity these authors mean the extension of tuberculosis along the mucous membrane of large bronchi leading out of tuberculous cavities. The most infrequent mode of infection they consider to be by implantation from the sputum. In their opinion, the mucous membrane

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with its cilia, aided by the cough, opposes a stout barrier against infection. Bugher,[2] on the other hand, in his article states that implantation from the sputum is the most frequent way of infection.

The clinical classification is made according to the site of the first attack. If the infection is by implantation, and this undoubtedly occurs, the disease appears as large or small, deep or shallow, ulcers in the mucous membrane. The question can be raised as to whether or not the use of pneumothorax and other methods of treatment designed to put the lung at rest do not promote the appearance of ulcers, for it must be remembered that a lung at rest no longer has at its command a powerful cough to clear the bronchi of sputum. It may easily come about that sputum, depending for its removal on the cilia only, will lie much longer in contact with the mucous membrane than if the cough were also present, hence there is increased opportunity for invasion of the mucous membrane and the production of ulcers.

The ulcers have a natural tendency to heal. In healing they produce scar tissue and so arises the second class of case, that with shrinking and formation of scar tissue in the bronchi. These cases when bronchoscoped may show a bronchus narrowed or completely closed by a dense mass of scar tissue. The clinical appearance of the case will depend on the presence or absence of cavities beyond the stricture and on whether or not those cavities if present are infected. If infected, they will show all the symptoms of an undrained lung abscess with cough, fever, occasional expulsion of large quantities of pus, if the bronchus is more or less open, and frequently severe pain in the chest.

Stricture of the bronchus may be brought about in another way. If the mucous membrane is infected by continuity, the disease creeps along under the surface without breaking through and forming ulcers. The consequent great increase of thickness of the mucous membrane will almost close the lumen of the bronchus and bring about the symptoms of poor drainage. If this process heals, shrinking and contraction will cause a great distortion of the bronchial tree (case of Caruso).

In speaking of pathogenesis, the existence of peribronchial infection was mentioned as bringing about infection by contiguity owing to the presence of diseased lymphatics and lymph nodes about the walls of the main bronchi. A defensive proliferation in the walls of the bronchi might close this avenue of infection, but contraction of the defensive tissue would in turn distort the bronchi and cause obstruction of the lumen.

Another clinical appearance is caused by the presence of diseased and enlarged lymph nodes in the mediastinum. These may increase to such a size as to close a main bronchus by pressure. At times these glands will break down and erode their way into the lumen of the bronchus. Then appear all the symptoms of an obstructed bronchus, with collapse of the lung supplied by that bronchus, and if a sufficiently large amount of lung is collapsed, the clinical symptoms of severe dyspnea and cyanosis. Should the disease of the bronchial wall be sufficiently severe, the supporting cartilages may be destroyed and then the shrinking and distortion are of extreme degree.

Another form which tuberculosis of the bronchi may take is the formation of tumors in the bronchi. These may be on the bed of an ulcer or take on the appearance of a tumor springing out of an intact mucous membrane. The symptoms caused by a tumor will be according to its size. A small tumor may manifest itself only by hemorrhage. A pedunculated tumor (quote case of nurse) may give a bizarre symptom of a fluttering noise at the mouth on deep breathing or coughing. If the tumor is obstructive but not completely so, wheezing may be complained of. If a large bronchus or the trachea is obstructed, the complaint may be of dyspnea and cyanosis so closely resembling asthma that the diagnosis of asthma is frequently made.

To sum up then the ways in which tuberculosis may attack the trachea and main bronchi: There may be shallow ulcerations; tuberculous tumors within the lumen; a general thickening and distortion of the wall of the trachea or bronchi; and finally pressure from the outside by enlarged lymphatic glands. The healing of the ulcers may cause such formation of scar tissue as to close the lumen.

How are these cases presented to the bronchoscopist? In the following ways: First, as to cases of ulceration:

A young woman, a nurse, for five months had had an irritating dry cough; no fever; slight loss of weight and strength. X-rays of her chest showed the left upper lobe to be a little emphysematous. On fluoroscopy it was noted that the mediastinum moved a little to the left on inspiration; also she complained of rattling in her chest and a fluttering rale could be heard at her mouth when the bowl of the stethoscope was placed there. These were considered to be the signs of partial obstruction of the left upper lobe bronchus and it was suspected that a foreign body was present. She was bronchoscoped and a shallow ulceration was found on the outer wall of the left main bronchus extending from the bifurcation down to the mouth of the upper lobe bronchus. At the lower end of this ulcera-

tion, partly covering the mouth of the upper lobe bronchus, was a piece of loose membrane which moved to and fro as she breathed. It was thought that this membrane accounted for the fluttering and wheezing. Smears taken from the surface of the ulcer showed the presence of tubercle bacilli. This was the first time that tuberculosis had been suspected.

As another example of ulceration of the bronchi, I might cite the case of a doctor of forty-five. After two years of persistent treatment for tuberculosis, as tubercle bacilli continued in his sputum, artificial pneumothorax was induced on the right side, since the physical signs were more extensive on that side. In spite of what seemed to be an excellent collapse, the sputum remained positive. Among his other symptoms he had considerable wheezing and clicking as he breathed, and a bronchial lesion was suspected. The bronchoscopy showed a shallow ulceration in the left main bronchus extending upward for about an inch from the mouth of the upper lobe bronchus. Some sputum was found to be coming from that side. The mucous membrane of the right main bronchus, which was the one on which pneumothorax had been done, was negative.

Several questions arose in connection with this case, the chief of which was, Should the right lung be allowed to re-expand and the left in its turn collapsed, since tubercle bacilli seemed to be coming from that side? However, a bronchoscopy, six weeks after the first one, showed that the ulceration had healed, and in another month his sputum was negative. I think that this case suggests that in some instances anyway it might be wise to bronchoscope tuberculous cases before doing a pneumothorax.

As an example of tuberculous tumor formation, allow me to quote the following case: A young woman was prostrated by an attack of what was thought to be pneumonia of the right lung. She was not perilously ill, but when the time arrived for her pneumonia to subside, she did not get well and continued to have afternoon fever, poor appetite, loss of weight and prostration. The signs in her lung were obscure; the sputum was negative. Bronchoscopy revealed a mass of granulation tissue in the mouth of the right upper lobe bronchus, with very scanty sputum. A biopsy showed it to be tuberculous, and a specimen of sputum taken from beyond it was also positive.

This case was presented to me as a problem in diagnosis. The symptoms made one suspect that she might have a foreign body, whereas it was a case of tumor formation, and the tumor so blockaded the bronchus as to permit the securing of no positive sputum.

Tumors may also appear in the bronchi of patients in whom the course following surgery appears to be otherwise favorable. A young woman with tuberculosis had had rather extensive thoracoplasty. The progress of her tuberculosis was favorable, but she had a wheezing as she breathed so loud as to annoy her. This wheezing could also be heard by the surrounding spectators. Bronchoscopy showed a mass of granulation tissue sticking out of the mouth of the left upper lobe bronchus into the main bronchus. This mass of granulation tissue was destroyed by coagulation and the application of silver nitrate. The mouth of the left upper lobe bronchus appeared normal except for some slight redness and yet the wheezing persisted. By the use of an angle mirror through the bronchoscope a small mass of granulation tissue could still be seen in the upper lobe bronchus. The fact that air still moved in and out of this bronchus sufficiently to cause a wheezing suggested that the surgery had not yet sufficiently immobilized the lung.

As an example of scar tissue formation closing a bronchus, allow me to describe the following case. A young woman underwent successful collapse of the left lung for extensive tuberculosis. The x-rays, however, showed that cavities were still present containing fluid. Her symptoms were not relieved. She continued to cough, to have fever and pain in the chest and to spit up considerable quantities of foul pus. The bronchoscopy showed the left main bronchus shrunk at its mouth to about one-quarter inch and the remaining lumen to be occupied by a mass of granulation tissue. This granulation tissue was removed and a considerable amount of pus aspirated from beyond the stricture. This patient required many repeated bronchoscopies in order to keep the stricture open and to aspirate pus from beyond it. Ultimately, however, the cavities dried up, cough, pain and fever disappeared. Symptomatically the patient is well.

When one had had less experience, it was thought necessary to keep dilating the bronchus in order to provide for drainage of possible infection. Now the thought comes to one, why it is not a good result if the bronchus closes altogether? There is a sealed sterile cavity, a mass of scar tissue, to be sure, but one which can do no harm in its sterile condition. Nature has in effect done a pneumonectomy. It is considered that no other treatment is indicated at the present time. This last case showed spontaneous healing. Undoubtedly this woman had ulcers in the left main bronchus. Their healing caused contraction and consequent damming up of secretion beyond.

As mentioned before, occasionally tuberculous lymph nodes will erode the wall of a bronchus and on breaking through cause severe

symptoms. A young child, known to be tuberculous, suffered a sudden attack of dyspnea and cyanosis. Examination showed a massive atelectasis of the right lung. Bronchoscopy revealed that the right main bronchus was full of caseous material which on its removal appeared to have gained entrance to the lumen of the bronchus through a hole in the wall leading to the mediastinum outside. This removal of the obstructing tissue relieved the dyspnea and the collapsed chest, as the removal of any obstructing foreign body from a bronchus will. The child made an excellent recovery.

Frequently the outcome in rupture of tuberculous glands into a bronchus is not so fortunate as in the preceding case. A middle aged doctor known to have tuberculosis and showing shadows of enlarged glands in the mediastinum developed the symptoms of tracheal obstruction and later those of tracheo-esophageal fistula. A bronchoscopy showed caseous material in the trachea and a large opening in the posterior tracheal wall. An esophagoscopy revealed a perforation of the wall of the esophagus at a corresponding place. A mass of tuberculous glands had eroded both the tracheal and the esophageal wall.

Here is a case illustrating another method of obstruction; that is, by cheesy material thrown into a bronchus from a cavity. A young child, an infant with septic temperature, reacting positively to the von Pirquet test, showed collapse of the right lower lobe. Bronchoscopy showed the right lower lobe bronchus to be full of white cheesy material evidently extruded into the bronchus from a tuberculous cavity.

The question is frequently asked of the bronchoscopist, why is the sputum of this patient still positive? He has a successful pneumothorax; the lung which has been diseased is completely and successfully collapsed. He had a period during which the sputum was negative. In such cases bronchoscopy will probably reveal ulceration of the mucous membrane either in the bronchus of the same side or of the opposite side. It is so with hemorrhage; where a case has been seemingly successfully treated for some time, hemorrhage will sometimes occur. The source of the hemorrhage will probably be granulation tissue or tuberculous tumor in one of the main bronchi.

As to treatment, as proved by autopsy, tuberculous lesions of the trachea and bronchi will heal spontaneously. Moreover, after the diagnosis has been made by bronchoscopy, it has come about that the symptoms will disappear and the patient spontaneously recover. As bronchoscopy is more frequently done in tuberculous cases, it is found that in many cases areas of scar tissue show that tuberculous

ulcers have some time been present; hence arises the question of treatment. Some authors even say that no treatment other than that of tuberculosis in general is indicated or needed, especially in those cases where there are no severe symptoms. Suppose, for instance, that in a case with positive sputum, doing fairly well, a small ulcer is found in the bronchus. Is one in such a case justified in repeating the bronchoscopy in an endeavor to heal the ulcer, which may after all heal spontaneously? The answer of this author is, yes. The ulcer may indeed heal spontaneously but on the other hand it may not. It may increase in size and then heal spontaneously. Under these conditions the ulcer contracture might put the other lung out of business as well as the diseased lung, so it would appear that the thesis that small ulcers should be treated can be defended.

Several methods of treatment have been used by this author for flat shallow ulcers. That first used was coagulation with diathermy. This was found to work well in a number of cases, but there are two objections to it. The ulcer scar tissue may be excessive and it may be dangerous.

A young woman, under treatment for tuberculosis, had an ulceration and a tumor in the right main bronchus. This lesion was treated by coagulation several times and healed rapidly. At the last treatment a very small shallow ulcer was found to be still present. It was coagulated and an uncontrollable hemorrhage occurred, resulting in death. At autopsy no penetration of any large vessel could be found. It is safe enough to coagulate tumors, but coagulation of flat ulcers, where the wall is exposed to the possibility of penetration, should not be done. The removal of tumors which are obstructing the bronchi needs no defense. All will agree that such lesions should be removed. They may be removed either by biting forceps, applications of silver nitrate or coagulation. In cases where the obstruction of a bronchus leads to damming up of secretion and the formation of secondary abscesses beyond, the indication for bronchoscopy and aspiration is thoroughly recognized. In such cases repeated bronchoscopies with stretching of the stricture and aspiration are justified.

I wish to present here a suggestion for dilating these strictures. It is known that the application of the negative pole of a galvanic current will soften scar tissue. I have had made an applicator for passing through the bronchoscope with different sized copper tips. With this applicator successive sizes can be applied to a stricture for about three minutes at a session, with the possibility of permanently enlarging the lumen. I have used this method as yet in very few cases. I know that the use of the ordinary glove stretcher dilator and

ordinary sounds is unsuccessful, as these strictures invariably contract again after stretching.

Where the obstructing agent is a mass of thick mucus or mass of cheesy material from tuberculous cavities which have been forced into the main bronchus, removal by aspiration hardly needs any defense. In a similar way obstruction of a bronchus by rupture into it of a gland should be relieved by aspiration through a bronchoscope.

The treatment of the shallow ulcers by coagulation has already been mentioned. Application of silver nitrate, 10 per cent, to these ulcers has already been used as a method of cure. It has been shown, however, that the application of silver nitrate to bronchi may result in the formation of scar tissue and even strictures may be induced. The aim of the treatment should be the healing of the ulcer with as little scar formation as possible.

I wish to suggest here another method, that is, the application of a quartz rod through the bronchoscope. With an applicator which has a small quartz bulb at the end, quartz rod rays may be applied to the surface of the ulcer. The use of such light in the larynx is well known and proven to be of benefit. There is no reason why it should not also benefit tuberculous ulcerations in the trachea and bronchi. I have used this method on only a few cases and over a short period, so that it has hardly been proven, yet it appears to be worth while.

Summing up then, we have the treatment of ulcers by coagulation, silver nitrate and the quartz rod; of strictures by stretching with copper ionization; of tubercular tumors by removal with forceps or coagulation; of obstruction, either by a mass of mucus or a mass of cheesy material in cavities or by a mass of cheesy material in ruptured glands, by aspiration; of secondary abscesses or of bronchiectasis beyond strictures by aspiration.

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LXIX

TECHNIC OF BRONCHOGRAPHY*

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AND

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PHILADELPHIA

It has been ten years since the subject of bronchography was discussed at length in a meeting of the Bronchoscopic Society, and in view of the great importance of this procedure as a supplementary study to diagnostic bronchoscopy, it seems about time to bring it up again for consideration. At the meeting in 1927 two papers were read, one by Kernan[1] and one by the late Campbell Smyth and Leroy Schall.[2] Kernan stated that "the bronchoscopist should be the one to introduce lipiodol into the lung," and he advised fluoroscopic guidance during instillation. Campbell Smyth and Schall spoke of the "uses and limitations" of the method. These latter writers stated that they "did not bronchoscope tubercular patients, much less put lipiodol into such cases." It is interesting to note the changed attitude of the profession on this point. Many workers (e. g., Buckles,[3] Eloesser,[4] Phelps,[5] Myerson[6] and Clerf[7]) have now reported large series of cases in which bronchoscopic studies have been carried out; and others (Potter,[8] Cabitt, Singer and Graham,[9] Neuhof[10] and Lasagna[11]) have reported large series of tuberculous cases in which bronchographic studies have been done with no objectionable effects. However, it is generally agreed that the instillation of lipiodol is contraindicated in the presence of acute exudative tuberculosis. Campbell Smyth and Schall emphasized the importance of several points in connection with the diagnosis of abscess already mentioned by Mosher,[12] Furstenberg and Hickey[13] and other writers; they called attention to the difficulty of filling a true pulmonary abscess with lipiodol, and the danger of interpreting the dense shadow of an area of "drowned lung" into which the oil has been injected too forcefully by inserting the instillation tube directly into a small branch bronchus, as an abscess. This fallacy was a common cause of error in the

*Read before the American Bronchoscopic Society, Atlantic City, June 2, 1937.

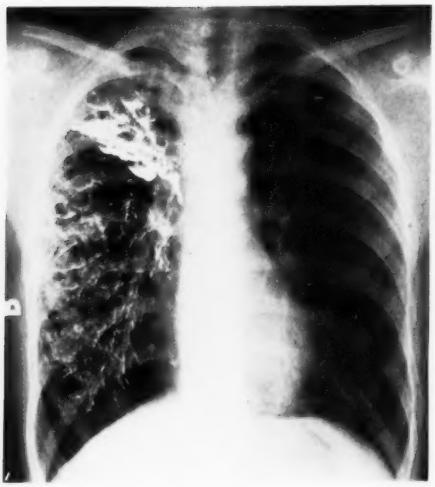

Fig. 1. The bronchoscopic technique was used for instillation of lipiodol into the right upper lobe in this case. The curved flexible tipped metal tube was introduced into the right upper lobe bronchial orifice, with the patient lying on his right side.

earlier days, but is now generally recognized. The two papers above mentioned were discussed by Chevalier Jackson, Clerf, Chamberlin, Iglauer, Carmody, Imperatori and Crosby Greene.

HISTORICAL NOTE

It is not our intention to review at length the history of bronchography nor to comment individually on the various technics devised. For a very complete treatment of the subject, with excellent bibliography, the reader is referred to the excellent monograph of Bonnamour, Badolle and Gaillard.[14] It is of interest, however, to note that four years before Chevalier Jackson[15] began his pioneer work with bismuth powder, lipiodol was first introduced by Lafay[16] in France (1901), not as a contrast medium, but as a drug to be used in the treatment of syphilis. Shortly afterward there appeared an excellent paper by Martin[17] on the therapeutic use of lipiodol in respiratory disease. It remained for Rist to discover that this substance was very opaque to the roentgen ray, and for Sicard and Forestier[18] to advocate its use as a contrast medium twenty-one years later (1922).

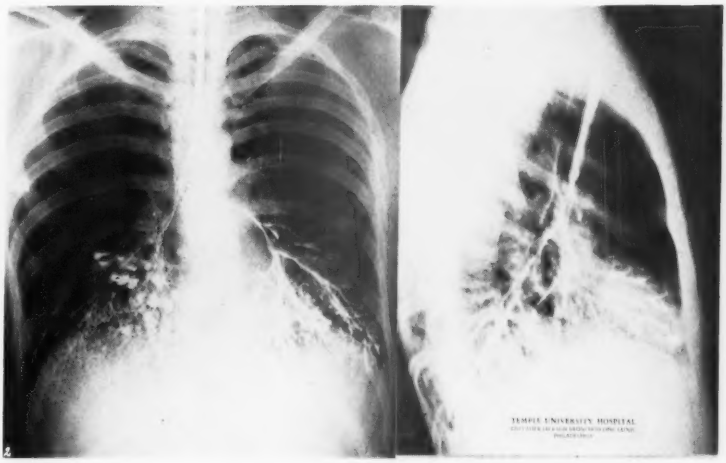

Fig. 2. Bronchiectasis of the middle lobe is beautifully shown in both anteroposterior and lateral projections. Note the catheter used for instillation of the opaque oil still in place. The lobar distribution of the bronchiectasis shows well even in the lateral projection in this instance, despite the bilateral filling.

Many of the earliest French workers to use lipiodol for bronchography (Sergent and Cottenot,[19] Armand-Delille[20] and others) advocated the inter-cricothyroid method, in which cricothyroid membrane was punctured with a needle. This method gave some very good results, but since many different workers reported serious complications following its use, it has now come into general disrepute and has been practically abandoned. In America the various supraglottic methods, such as the "aspiration" method of Singer,[21] the similar method of Pritchard[22] and the "passive technic" of Ochsner,[23] have been the most widely used. Recently Forestier and Leroux[24] demonstrated their modification of the pernasal technic originally proposed by Hicquet and Hennebert of Brussels. Forestier and Leroux dispensed with the catheter used by their predecessors. Most of the other methods may be considered under the head of "transglottic" methods. Among these may be mentioned the syringe methods in which a long curved cannula passing down through the glottis is used; the intubation method of Iglauer,[25] the bronchoscopic method (Clerf,[26] Ballon[27] and Tucker[28]) and the various catheter methods.

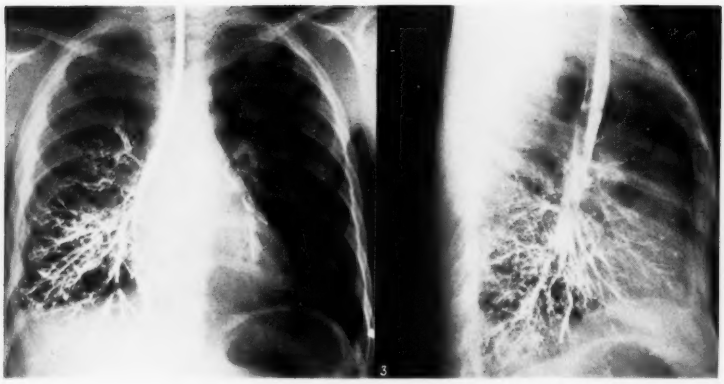

Fig. 3. Good filling of right lower lobe in a child 5 years of age, by the use of a catheter passed through the nose and directed into the larynx under direct laryngoscopic guidance. Note that, as in the previous case, the catheter was left in situ during the taking of the pictures. Note that a more satisfactory lateral view is obtainable when only one side is filled.

Until about five years ago the bronchoscopic method was the one used at the Temple University Bronchoscopic Clinic, and at the other Bronchoscopic Clinics of Philadelphia. However, we became dissatisfied with the method, for several reasons. Too much of the lipiodol was coughed out, especially in children; often there was some delay in transportation of the patient to the x-ray department or in taking the pictures. It was decided to investigate other methods, and first the supraglottic methods were tried, especially the "passive technic." Some good pictures were obtained, but not a high enough average of good pictures.

Next we began to test out various types of catheters, sometimes introducing them with stylettes of various types, and sometimes, as in the case of the Stitt catheter, without a stylette. It would be hopeless to attempt to describe and discuss all the types of catheters, stylettes and introducing apparatus that have been devised for or applied to the introduction of lipiodol. One very good instrument was presented by Myerson[29] at the meeting of the Bronchoscopic Society in 1928; other instruments and technics have been devised by Mounier-Kuhn,[30] Ramadier and Nattier,[31] Pitman,[32] Mandelbaum,[33] Lloyd,[34] and Thomson;[35] Garcia Vicente,[36] de Pablo[37] and

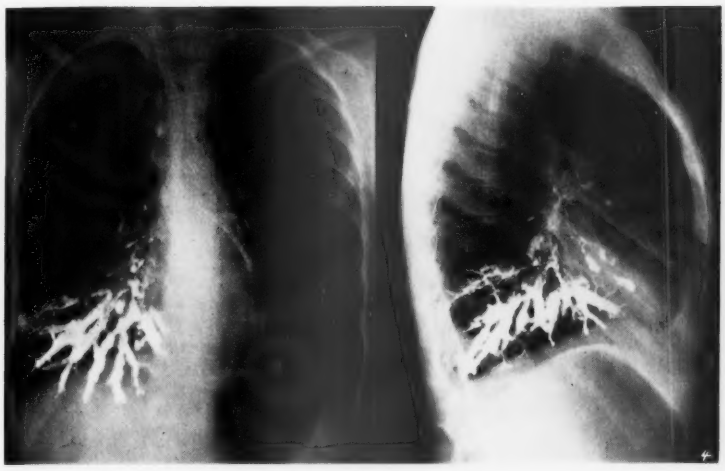

Fig. 4. Bronchography was done in this case, as in the preceding one, by the instillation of lipiodol through a catheter with the aid of the direct laryngoscope. The patient was a child 10 years of age. The catheter was removed immediately before taking the pictures.

Garcia Capurro[38] have devised forceps for the introduction of catheters; introducing apparatus of still different types have been described by Jacod[39] in France and by O'Sullivan[40] in Australia.

CATHETER TECHNIC IN USE AT TEMPLE UNIVERSITY BRONCHOSCOPIC CLINIC

(A) *Adults.*—For routine bronchography in adults we find the ordinary soft catheter, 16 Fr. (full length, not cut short), most satisfactory, and we generally introduce it through the mouth with a plain wire stylette bent to the particular "laryngeal curve" preferred, under the guidance of the laryngeal mirror. The preparation consists simply in keeping the patient fasting for a few hours before the procedure, and anesthetizing the pharynx and larynx by means of a spray of 10 per cent cocain, followed by a fractionated instillation of the same solution, using a laryngeal syringe under the guidance of the laryngeal mirror. In patients suspected of being sensitive to cocain, a larocain solution of the same strength is substituted.

Fig. 5. Another example of bronchoscopy in a child, by means of a catheter passed with the aid of the direct laryngoscope. In cases of heavy bilateral filling such as this, lateral roentgenograms are practically useless because of the superposition of the trees of the two sides. Stereo-antero-posterior views and oblique projections are best.

After introduction of the catheter, under guidance of the mirror, and withdrawal of the stylette, a small additional quantity of cocain or larocain solution is injected through the catheter, and then the patient is taken to the x-ray department, the proximal end of the catheter being temporarily fastened to the lip and cheek with adhesive tape. Behind the fluoroscopic screen the position of the tip of the catheter is determined, and if not satisfactory, corrected by appropriate manipulation of the catheter and the patient's head. If there is still a tendency to coughing, a few drops more of the anesthetizing solution can be instilled through the catheter. Next the oil is injected, either under fluoroscopic control or not, as desired, and the patient placed in various positions, according to the area that is to be mapped. In some cases the injection is made with the patient in lateral decubitus or in the "Cleopatra" position. If one base or any lobe is to be mapped, 10 cc. of oil will suffice, but if both bases or a whole lung is to be mapped, not less than 15 to 20 cc. should be used. There has been some difference of opinion as to whether or not the catheter should be left in situ while the pictures are being taken. We are of the opinion that it is much better to remove the catheter quickly

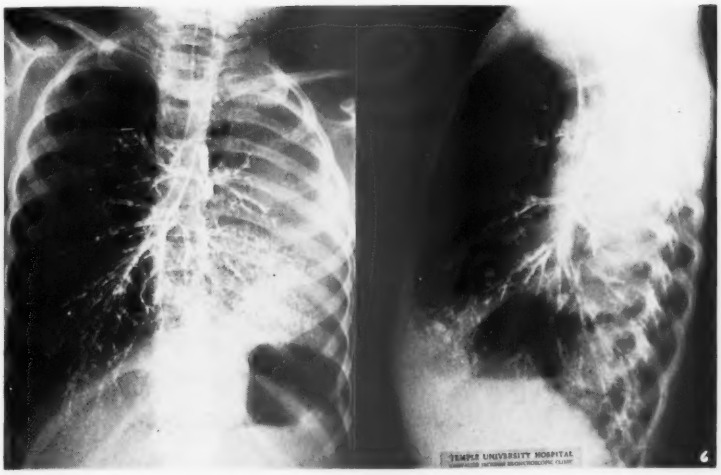

Fig. 6. Good filling of right lung in a patient with congenital atresia of the left bronchus. Again the technique used was the pernasal, direct laryngoscopically guided method.

as soon as the injection has been completed. We have observed that in the great majority of cases deft removal of the catheter does not provoke the cough reflex, and the patient is much more at ease and self-controlled for any subsequent posturing. The proper posturing for filling of the various portions of the lungs has recently been discussed in considerable detail by one of us (M. B.[41]).

(B) *Children.*—For bronchography in children we use the same type of catheter as in adults, but we introduce it through the nose and pass it into the larynx either under the guidance of the direct laryngoscope, as first described by one of us (C. L. J.[42]), or under fluoroscopic control. (A semi-rigid woven catheter may be substituted for the soft one if the latter tends to be coughed out.) If the direct laryngoscopic method is used it will be found surprisingly easy to direct the tip of the nasal catheter into the larynx, even without the use of a forceps, by merely manipulating the proximal end of the catheter. On the other hand, it is also quite satisfactory, and less uncomfortable for the patient, to insinuate the nasal catheter into the larynx under fluoroscopic guidance, tilting the head back just far

Fig. 7. Multiple bronchiectatic cavities of the right upper lobe well shown by antero-posterior and lateral projections. Note how well the lateral projection localizes these large cavities and the entire diseased process to the upper lobe. By contrast the lower lobe is seen to be quite normal. This case emphasizes the value of unilateral filling and study with the antero-posterior and lateral projections. Bronchographic studies of this sort are of the greatest value to the thoracic surgeon.

enough to cause the curve of the posterior nasopharyngeal wall to direct the tip of the catheter anteriorly into the larynx. It is remarkable how soon even an apprehensive child will become reconciled to the presence of the nasal catheter attached to his lip and cheek with a piece of adhesive tape. In order to help allay coughing, a small amount of 10 per cent larocain may be instilled through the catheter, but cocain is never used in children.

Some have raised the objection to this technique that the passage of a catheter through the nose and into the tracheobronchial tree may carry infection from the upper to the lower air passages. We regard this objection as unsound, since it is well known that secretions from the nasopharynx pass freely into the larynx and trachea during sleep, carrying down much more infection every night than could possibly be carried by the catheter. This objection may apply to the use of the pernasal technique of Forestier and Leroux in patients with a nose

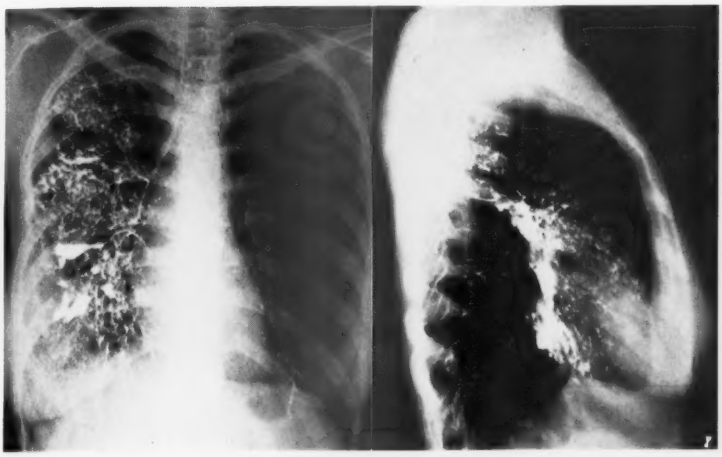

Fig. 8. Bronchography of the entire right lung in an adult, by the indirect, mirror guided method, using a soft catheter and curved wire stylette. Note that in the lateral projection the multiple cavities more clearly visualized in the antero-posterior view are seen to be located in close relation with the entire lobar septum. These pictures again emphasize the value of the lateral projection to the thoracic surgeon.

filled with purulent secretions, but we believe it is of no importance in the case of the catheter.

In either adults or children, when there is some reason for expediting the bronchography, we introduce the catheter immediately on withdrawal of the bronchoscope after diagnostic bronchoscopy, with the aid of the direct laryngoscope. In this way the catheter method can be made to approximate one of the features very properly regarded by Clerf as an especial advantage of the bronchoscopic technic, namely, a combination of diagnostic bronchoscopy and bronchography in one procedure.

ROENTGENOLOGIC CONSIDERATIONS

It is always preferable to map one lung at a time, but especially if the lesion is one-sided. This permits us to take a lateral as well as stereoscopic antero-posterior or postero-anterior views. The lateral projection is often of great value to the bronchoscopist in the lobar

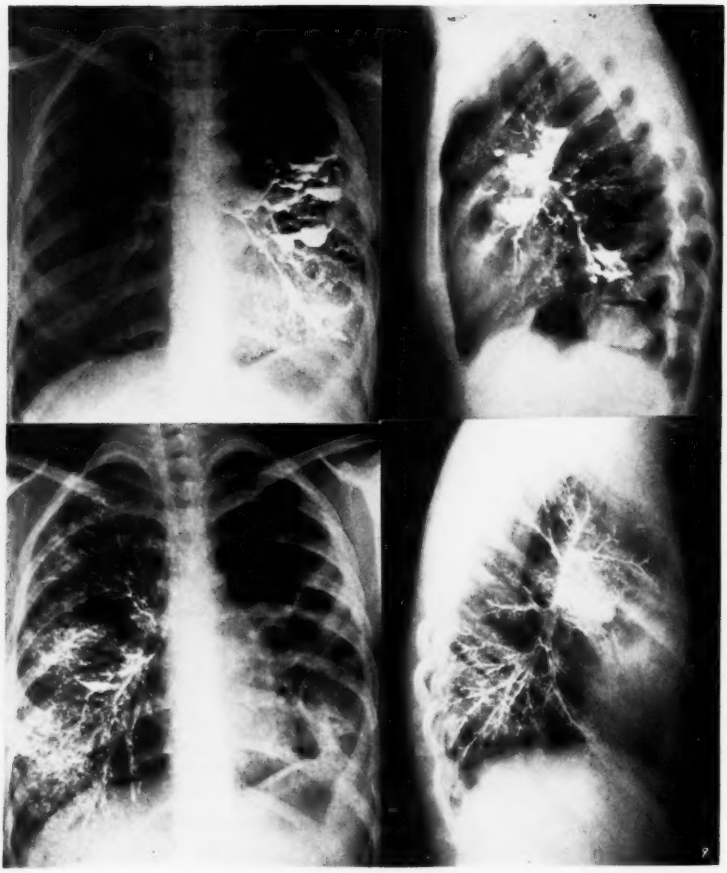

Fig. 9. Bronchographic studies in both antero-posterior and lateral projections of first the left lung, and at a subsequent sitting the right lung. Note again, as in the previous instances, that the lateral views are much more satisfactory if only one side is filled at a time, and note that the lateral projection shows especially well the lobar distribution of lesions. The indirect catheter technique was used.

localization of a lesion, but it is of little use if both sides have been filled, because of the superposition of the two sides. Both lungs may be injected at one sitting, however, if it is necessary to complete the study in one operation. In this case, stereo-antero-posterior or postero-anterior views are taken, with the addition of right and left obliques. If obliques are of good quality, they are of definite value, but too often they are not good.

An ingenious suggestion was made by Bethune,[13] namely, that when bilateral filling was desired, the more important side be injected first and a lateral quickly taken, after which the other side is injected and stereoscopic antero-posterior views taken.

In connection with the roentgen phases of the subject, mention should be made of the excellent work of Fariñas[11] in Havana. He has developed a technic of "serial bronchography" which he has applied to the study of suppurative disease, neoplasms and broncho-pulmonary tuberculosis.

Regardless of the technic used, the whole-hearted cooperation of the roentgenologist is necessary if good bronchographic work is to be accomplished. Not only must the quality of the roentgenography be of the highest, but the roentgenologist's aid in the posturing of the patient and in the choice of views to be taken to bring out the particular features of each individual case is indispensable. We wish hereby to acknowledge our obligations to Dr. W. Edward Chamberlain and his associates for their enthusiastic and skilled assistance in our efforts to perfect our technic of bronchography.

CONCLUSIONS

1. We believe the catheter methods for the instillation of lipiodol to be the best. The catheter may be inserted anywhere in the hospital, and thereafter the patient may be taken to the roentgen ray department with no additional apparatus except the syringe and the oil. The oil may be injected in the dark if desired, with the patient in any position, and directed into any part of the lungs, without risk of cough.

2. On the other hand, in advocating the catheter methods for bronchography, we do not wish to detract one iota from the prestige of diagnostic bronchoscopy. It is still true, as stated in the paper of Campbell Smyth and Schall, to which we have previously referred, that "any case which is obscure enough to require pneumonography as an aid in diagnosis is also obscure enough to be entitled to diagnostic

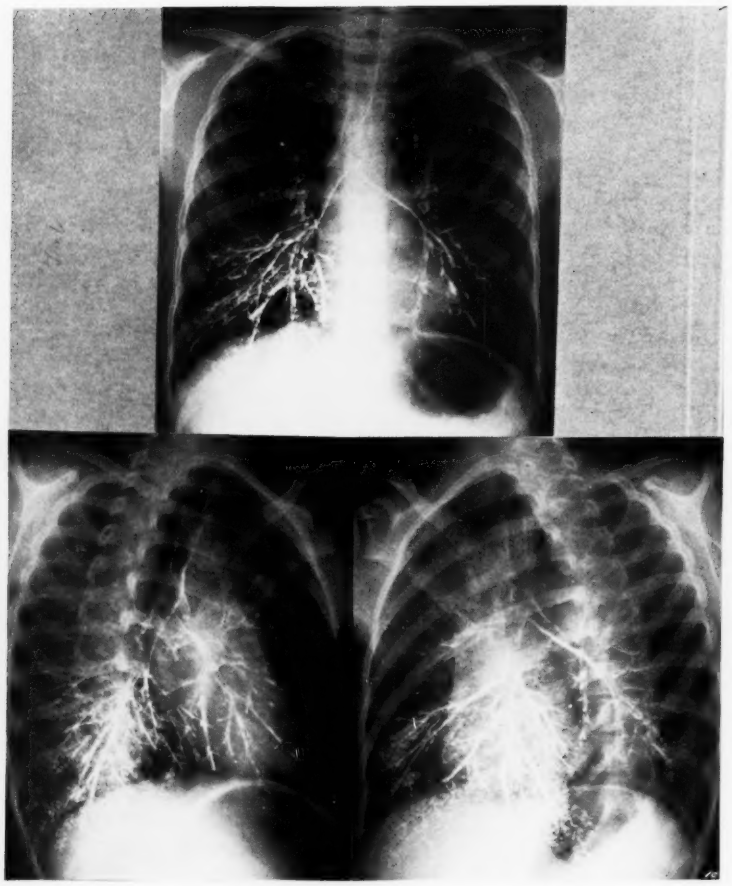

Fig. 10. This case illustrates the use of antero-posterior and right and left oblique projections in cases where it is desired to fill both sides at one sitting. This technique is quite satisfactory if the roentgenographic work is of high quality, though the pictures are not quite so easily interpreted with regard to matters of lobar distribution.

bronchoscopy," and we almost invariably do the diagnostic bronchoscopy first.

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LXX

TREATMENT OF LARYNGEAL PAPILLOMATOSIS*

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In an article written five years ago I reviewed the literature dealing with laryngeal papillomatosis and the various methods employed to overcome this condition.[2] As a result of satisfactory results obtained in a small series of cases by the use of x-ray radiation this method of treatment was heartily recommended to the profession. The technic used was described.

I intended to write nothing more on the subject until I had accumulated a sufficiently large number of cases to be conclusive either as to the value of the treatment or whether it was to be discarded as so many other procedures have been. Our secretary, however, has asked me to make a report and I am glad to do so.

Unfortunately I have seen only eleven cases of laryngeal papillomatosis since I began the use of radiation for the condition. Nine of these were in very young children and had had no treatment; one was a girl who had been operated on many times; one was a man of 50 who came in with a large papillomatous mass in the anterior part of the larynx. This was removed and he remained well for three years; then returned with the larynx filled with multiple papillomata.

Eight of the nine cases cleared up promptly under radiation and the children have remained well so far as I can find out, with the exception that one patient came back with a large papilloma in the trachea at the site of the tracheotomy wound. This was removed and there has been no recurrence. The case which did not respond is still under observation. It is a patient of one of my associates. I saw him and advised radiation. Some time later he was admitted to the hospital for a tracheotomy. The larynx had a large number of papillomata in it, which were swollen, dark red in color and bled on touch. Inquiry elicited the fact that it had been having x-ray treatments which had gradually been made more intense because it did not seem to be clearing up as it should. I feared that a slough was imminent, but gradually the swelling subsided, but a number of papillomata are

*Read before the Twentieth Annual Meeting of the American Bronchoscopic Society, Atlantic City, June 2, 1937.

present. What the result will be I cannot say. The patient that had been the subject of so many operations and the old man were not benefited.

I have endeavored to secure the cooperation of other laryngologists in trying out this treatment, but have not been particularly successful. I have had reports of good results in cases seen or treated by Arbuckle of St. Louis, Barr in Beaumont, Texas, and Barrow in Shreveport, La. Lejeune of New Orleans reports some good results, some poor. Jesberg of Los Angeles observed no benefit in several cases in which it was tried.

The literature dealing with this condition is interesting, but disappointing. From time to time good results, obtained by the use of various methods, are reported; later the same writers are found recommending something else. Contradictory reports on the result of the same line of treatment by different observers abound. Of course, the real trouble underlying our failure to solve the problem is that our knowledge of the subject is entirely empirical. We have no definite knowledge of the etiology and pathology of the condition. These growths are like the wind which "bloweth where it listeth and thou hearest the sound thereof, but thou cannot tell whence it cometh or whither it goeth."

Another trouble is that these cases are not sufficiently common to allow any one man to accumulate sufficient data to be convincing. Again some men have told me that cases have been seen, referred to radiologists and lost sight of. This can easily happen in private practice. The laryngologist is apt to lose interest in a patient when he is not looking after him directly. On the other hand, patients do not lend themselves readily to being shifted back and forth.

I do not wish to convey the impression that I am an authority on this subject, but six years of study and observation have driven me to a few definite conclusions. Future experience may prove them wrong, and if so I shall so report.

CONCLUSIONS

1. There is a decided difference between the papillomata that are congenital, or appear in early childhood, and the adult type. This fact has been noted by different writers. Crowe and Breitstein[1] described adult papillomata as papillary hypertrophies, while those in childhood are of connective tissue origin. These latter, however, when operated on repeatedly, assume a hard adult type.

2. I still believe that most, if not all, primary cases of papillomatosis of childhood are amenable to proper radiotherapy. By proper radiotherapy I mean low voltage, mild dosage. The best and quickest results I have seen have been obtained by the use of the technic described in my former paper:[2] 100 K.V., 5 milliamperes; 4 mm. aluminum screen; skin anode distance 15-18 inches, time 5-10 minutes. Treatments are given to alternate sides of the neck at intervals of from five days to a week. Have patience and do not try to hurry the result by increasing the dosage or the frequency of treatments.

I wish to stress the importance of the above for the reason that almost every radiologist wants to modify it. Some insist that the voltage is too low, that for proper penetration at least 150 K.V. should be used. Others maintain that one should figure out the dosage in R units and give that. The result should be the same whether given in a few or many applications.

I freely admit that I know very little about radiotherapy. The technic advised was arrived at more or less by chance. I wanted to try this form of treatment and the radiologist was frankly skeptical. I insisted and asked him to use treatment mild enough to insure against damage to the child's larynx. I am sure that I am not mistaken when I say that cases do not show the rapid improvement under higher voltage treatment.

We do not know why papillomata come or why they disappear. It is my belief that mild radiation stimulates some reaction in the tissues that promotes the disappearance of the growths. Radiologists do not accept this idea. They say that the only action of x-rays of which they know is destructive and that sufficient dosage must be used to destroy.

3. I have seen no good effects from the use of radiation in adult type papillomata. It is possible that some other technic might be of benefit.

4. In regard to tracheotomy: I do not do a tracheotomy unless there is sufficient dyspnea to make it advisable. It may be that laryngeal rest may promote disappearance of the papillomata, as claimed by good authorities, but I have seen as rapid improvement under radiation without tracheotomy as with. Of course many cases need it on account of dyspnea.

5. Operative work: Every case is carefully examined by the direct method and usually a biopsy specimen removed. If there is any large pedunculated mass, as there sometimes is in the anterior

commissure, this is removed, care being taken not to injure the subjacent tissue. No attempt is made to deal with the rest of the affected membrane.

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LXXI

LUNG ABSCESS: BRONCHOSCOPIC CONSIDERATIONS*

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AND

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DEFINITION

A lung abscess is a localized area of pulmonary alteration characterized macroscopically and microscopically by alveoli which are filled with a dense exudate composed largely of fibrin, with many leukocytes and red corpuscles and which may progress to the point of softening into a foul smelling, grayish, shreddy mass, semi-fluid in character, which is usually well marked off from the surrounding tissue by a zone of coagulated lung substance; this may progress further to cavities of considerable size, lined with ragged, floating shreds of dead tissue. It may be characterized clinically by an almost complete absence of symptoms or there may be an elevation of temperature, malaise, chest pain, productive cough of a foul odor, with chest findings varying from a simple friction rub to those found over large cavities, and it is further characterized by x-ray findings which may vary from a simple area of circumscribed parenchymal infiltration to that of cavities with the typical fluid line with air bubble overlying. Clerf[1] in his definition describes the condition as a circumscribed suppuration which eventuates in cavity formation.

PATHOLOGY

Bucher[2] feels that the organisms found in lung abscess are for the most part pyogenic in nature and contribute to the underlying cause, be it tissue damage from infarction or infection. The same author notes an almost constant change in the bacterial flora, even in the same patient. He further notes and, in this our experience coincides, that the organisms found in pulmonary abscess are similar, for the most part, to those found normally in the mouth and upper respiratory tract.

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*Read before the Twentieth Annual Meeting of the American Bronchoscopic Society at Atlantic City, June 2, 1937.

Zinn[3] feels that pathologically lung abscess shows little of importance to the bacteriologist.

Clerf[4] feels that the influence of an obstructed bronchus on the normal drainage of bronchial secretions may exert a remarkable influence on the occurrence of a pulmonary suppuration and in which, if the obstruction is of brief duration, little lung damage ensues. Prolonged obstruction, however, he feels, may lead to most serious results, namely, pulmonary abscess, bronchiectasis, pulmonary fibrosis, pyopneumothorax and bronchial stricture.

Lambert and Weeks[5] express the opinion that anaerobes are not only secondary invaders but can and do cause pulmonary suppuration primarily.

Harkavy[21] was able to produce suppurative pneumonitis and extra-bronchial abscess in dogs by the aspiration method and suggests that the aspiration of infectious material from the upper respiratory tract in man, reasoning by analogy, may produce pneumonitis, necrosis and cavity formation which may heal or persist with eventual formation of a typical lung abscess. He makes the further important observation that pulmonary abscess, in five of eight dogs tested, indicated that chronic sinus infection may, in some way, contribute to the formation of a lung abscess, and it was also his opinion that bronchial obstruction was essential in the production of lung abscess in the dog, irrespective of organisms introduced.

Hall and Thomas[26] state there is a tremendous amount of sinus disease associated with moist lungs and, regardless of the theories advanced to explain this co-existence, that clinical fact is established.

Van Allen[23] and others found that abscess developed much more readily from pulmonary emboli than from intrabronchial inoculation of the lung.

Salkin, Cadden and McIndoe,[6] in speaking of tuberculous cavities, suggest that some of the important unsolved problems are the exact method of cavity healing; the cause of recurrence in healed cavities and the rapid changes in the size of certain cavities. They regard the cavity wall as physiologically inert but suggest that evidence is accumulating to show that it may be very active in determining the gases, liquid content and pressure where a cavity exists. This may have its application in nontuberculous cavities.

Tucker[7] feels that free endobronchial drainage is necessary for the resolution and cure of tracheobronchial infection. He feels that if drainage is blocked the chances of the lung overcoming the infec-

tion are very much less and there ofttimes develops atelectasis, "drowned lung," lung abscess or a chronic suppurative pneumonitis which may be followed by fibrosis and bronchiectasis. He suggests that the so-called "unresolved pneumonias" have been proved to be a bronchial obstruction which did not clear following removal of the obstruction by bronchoscopy.

Jackson and Jackson[8] also refer to the "drowned lung" as being due to a blocked bronchus and that it differs from a true abscess in that it may develop rapidly and is relieved almost as quickly by a removal of the blocking material. If, however, the blockade is not removed, pulmonary suppuration follows.

MacCallum[9] states that in a lung abscess the following conditions are found chronologically: At first the involved focus is very hemorrhagic, soon becomes gray, solid or develops a rapidly liquefied center surrounded on all sides by a barrier zone of hemorrhagic pneumonic consolidation, and surrounding this area the lung tissue proper is edematous. He further states that the origin of such a lesion can often be traced to a whole colony of organisms lodged like an injection mass in the lumen of a central blood vessel.

Graham[10] has noted that a solitary lung abscess may be associated with bronchiectasis. When such a lung abscess is treated early, the latter usually heals, but if the abscess does not heal, the associated bronchiectasis becomes obstinate. He has also noted the lack of agreement or criteria by which one may define acute or chronic lung abscess. He has chosen empirically the term chronic for those abscesses which are of eight to twelve weeks' duration.

SITE OF ABSCESS

Clerf[1] noted that pulmonary abscess may be single or multiple and occur in any part of the lung, but that they were localized in one lobe in 79.3 per cent, in two lobes in 19.5 per cent and in three lobes in 1.2 per cent in a series of 169 cases. He further observed that the lower lobes, and especially the right, are usually considered more frequently involved, but in his experience involvement of the upper lobe was more common.

Moersch[22] in his series of 105 cases found that the right upper lobe and the left lower lobe respond less favorably to treatment. He gave no percentage of site of occurrence.

Miller[12] reports in 100 cases that 39 per cent were in the upper lobes, 10 per cent in the middle lobe and 46 per cent in the lower lobes. In 4 per cent, more than a single lobe was involved.

In our own experience in a series of twenty-four cases, 42.5 per cent occurred in the right lower lobe, 20.8 per cent in the right mid-lobe and 37.5 per cent in the left lower lobe, 4.25 per cent in the right upper lobe and in one case the left upper and lower lobe were both involved.

ETIOLOGY

Clerf[13] found 70 per cent of a series of 172 cases followed surgical operations. Tonsillectomy constituted 56 per cent of these operations and 8.1 per cent occurred following operations on other parts of the body; the remainder followed injuries, acute upper respiratory infections and other similar incidental factors.

Jackson and Jackson[11] feel that there is a large unsettled question of the role played by descending upper respiratory infections in patients not operated upon, and they further state that in almost all of their nonoperative cases of pulmonary suppuration, potentially pathogenic suppurative foci existed in the tonsils, teeth or sinuses as probable causes.

Miller[12] in a review of 100 cases of lung abscess reports seven followed pneumonia, eighteen followed operations and of these twelve were tonsillectomies, eleven of which were performed under general anesthesia. In three cases a tracheobronchial foreign body was found and in twenty-three there was a definite possibility of aspiration factors.

Clerf[4] states that the occurrence of abscess of the lung as a complication of foreign body has been an uncommon experience to him.

In our own series of twenty-four cases, of which 25 per cent were acute and 75 per cent were chronic, there were six postoperative tonsillectomies, three following an upper respiratory infection, two following operations on the abdomen and one following pneumonia, four following foreign bodies, one following fracture of a homolateral maxillary sinus with empyema of the antrum, one following fracture of a femur, and seven did not seem to have any specific contributing history.

SYMPTOMS

The symptoms of lung abscess are quite varied. Some of the cases are discovered accidentally by x-ray when the patient presents with symptoms of malaise and slight cough which is not always productive early in the disease. These symptoms may then become quite marked, at which time there will be pain in the chest, fever of variable degree, cough with or without expectoration early in the disease which tends to become purulent and foul as the disease progresses.

Fleick[1] and others, in an analysis of 114 cases, found cough present in 99.1 per cent, expectoration in 86.8 per cent, pain in 71.5 per cent, hemorrhage in 44.7 per cent, dyspnea in 13.1 per cent and a variable degree of fever in 62.2 per cent.

Kessel[24] in a series of cases reported the outstanding symptom to be hemorrhage.

In our experience, hemorrhage has occurred in about 20 per cent of the cases. However, we have had three cases of pulmonary bleeding, for which we have never been able to find on x-ray, physical examination or by any other method, a logical explanation.

Graham[14] found cough of a productive character with sputum often blood stained, fetor, fever, chills, sweats and chest pain as well as loss of strength and appetite to be the more common symptoms and in that order of frequency in his series of ninety-four cases.

DIAGNOSIS

The diagnosis of lung abscess is dependent, in our opinion, upon x-rays more than any other factor. We have had several patients who had symptoms common to many lesions, and only by methodic, careful study were we able to isolate the condition. We believe that x-ray is the most important single factor in the diagnosis of pulmonary abscess, and this is especially so in the early cases. Of course, the other factors that make for the diagnosis of a lung abscess, when it is sufficiently advanced, may vary from those found in a simple pneumonitis with a slight friction rub to the well known signs of cavitation. The differential diagnosis of course is important. But the factors to be considered are well known to a group of this character.

Graham[15] has quite aptly stated that there are no physical signs in pulmonary abscess that are pathognomonic; he further states that about the only important evidence that is gained by physical examination is in the demonstration of a cavity or cavities. He very pointedly remarks that it is notorious that small cavities are much more likely to be overlooked by methods of ordinary physical examinations than by roentgen-ray examination.

TREATMENT

The treatment of lung abscess seems to have two different schools of thought; this, in our opinion, is unfortunate. One school holds to the proposition that these cases have a percentage of recoveries without any treatment, the average seeming to be about 25 per cent. However, the cases that do not heal, which number about 75 per cent, require chest surgery ranging from simple thoracotomy with

cautery uncapping a lung abscess to that of lobectomy, single or multiple. When it is recalled that the vast majority of acute lung abscesses treated bronchoscopically show a recovery rate of 80 to 90 per cent, we cannot agree with the so-called conservative school, and especially when bronchoscopy is, after all, a minor procedure in the hands of skilled men.

Clerf[1] stresses the importance of a diagnostic bronchoscopy in all cases of pulmonary abscesses unless distinctly contra-indicated, irrespective of the method of treatment to be employed later.

Tucker[16] states that bronchoscopic treatment in many of these conditions has been of great value, and in cases of lung abscess following a foreign body there has been a cure in 98 per cent.

Vinson[17] has made the important observation in several instances of what he had diagnosed as embolic abscess not associated with bronchial stenosis, in which spectacular results have followed bronchoscopic aspirations.

Zinn[3] notes that in newly formed lung abscesses, bronchoscopic drainage offers the best results, and he goes on further to state that many of the patients will be absolutely cured of the abscess after three or four bronchoscopies.

Jackson and Jackson[11] have urged bronchoscopy at the earliest possible moment in all varieties of postoperative pulmonary complications and quite rightly note that "to say the bronchoscopic aspiration is not needed in any case on the basis of recoveries without it, is equivalent to saying that blood transfusions are not necessary because of recovery in cases where it was indicated but not given." He further has noted that it is not necessary that the bronchoscopic tube always be inserted into the abscess cavity nor out to the periphery of the lobe.

In the opinion of Leon-Kindberg[25] and others, spontaneous recoveries from pulmonary abscess occur in from 20 to 25 per cent of the cases, and he further states that surgical intervention (bronchoscopy?) is often necessary, but it is usually inadvisable before the eighth week. He goes on to state, however, that bronchoscopy should be used in the cases that have passed the acute stage, as it will effect a cure in many.

Moersch[22] notes, in our opinion, a very important point. He stresses that it is important to avoid continuing treatment over too long a period of time, giving as his reason that it increases the surgeon's difficulties. We would like to supplement his reason with an-

other one equally as important—to avoid discrediting bronchoscopy in the management of these cases. He goes on to state, however, that bronchoscopy should be used in conjunction with medical and surgical treatment, as it affords one of the most efficient measures in the treatment of pulmonary abscess. This again stresses the importance of team work.

Fleick[1] and his associates stress the necessity of bronchoscopy in cases of pulmonary abscess irrespective of the method of treatment later to be employed. He too has noted that conservative treatment should not be continued too long if distinct benefit is not obtained, since complications may occur which decrease the chances of recovery when surgical intervention is made.

Graham[10] notes that bronchoscopy in either the acute or chronic lung abscess endeavors to promote drainage and as such it is thus an aid to postural drainage. He further notes that bronchoscopic methods enable one to remove granulations, dilate strictures and aspirate secretions which the patient is unable to expectorate and rid himself of by postural drainage. He also very pointedly notes that there is a question of whether or not early bronchoscopy might not prevent the spread of the lesion, not only on the affected side but occasionally to the opposite lung. He mentions the prevention of bronchiectasis if such measures are adequate.

We have treated twenty-four lung abscesses. We have seen several others in consultation whom we were not permitted to even bronchoscope. Of these twenty-four cases, seven were acute lung abscesses, six of the seven were cured by bronchoscopy and forces of nature combined. Of the seventeen chronic lung abscesses one, or 5.5 per cent, responded to bronchoscopy alone; 2, or 11 per cent, responded to bronchoscopy combined with thoracotomy and uncapping of the lung abscess. Thirteen, or 83.5 per cent, did not respond to bronchoscopy and will require radical chest surgery if a convalescence is to be had. There have been two deaths, or 11 per cent, while under active treatment.

In the management of the chronic lung abscess we have been willing to bronchoscope the patient only so long as there was combined evidence on x-ray, general condition and physical examination to show tangible improvement. When we could not show improvement we have discontinued bronchoscoping the patient and have requested, and in a few instances, obtained external surgical drainage. We feel that it is most important that the bronchoscope be limited to those cases in which even the most pessimistic physician can be convinced of improvement, as in the locality in which we live, even with

a great deal of favorable evidence for the bronchoscope it is looked upon querulously by too many of the profession.

PROGNOSIS

Zinn[3] states, and in this our experience coincides, that in a newly formed abscess, bronchoscopic drainage offers the best result, and many such patients will get an absolute cure of the abscess after only three or four treatments. He mentions surgical drainage and states that perhaps 50 per cent of these cases will leave the hospital as cured, 30 per cent will be improved, with the other 20 per cent being unimproved. His experience of the recurrence of lung abscess in the so-called cured individuals has not been borne out in our practice.

Jackson[20] reports that in 98 per cent of foreign body lung abscesses, a cure will be effected by a proper bronchoscopic removal and treatment.

Leon-Kindberg[25] reports spontaneous recovery from pulmonary abscess in 20 to 25 per cent of the cases. He does not give the percentage of recovery following various types of treatment of the unfortunate remaining 75 per cent.

In our own series of twenty-four cases 25 per cent have been acute and 75 per cent have been chronic. Of the acute cases 83.5 per cent were cured by bronchoscopic methods combined with good general care; 16.5 per cent required bronchoscopy with external surgical drainage, but of these acute cases 100 per cent are well. Of the chronic cases there were two deaths while under active treatment: one from massive pulmonary hemorrhage, the other from sepsis; two, or 11 per cent, had external surgical drainage and are well; 14, or 78 per cent, are still sick, and these fourteen, if they are ever to be well, will require radical external surgical approach.

In the preparation of this paper a few interesting questions have occurred to us which we have been unable to answer adequately. One of these questions is, why do certain lung abscesses fail to heal with apparent adequate drainage? We have thought of pleural adhesions, supportive peripheral bands of fibrous tissue in the lung tissue per se and a fibrous capsule about the abscess lined with an epithelial or pyogenic membrane. We have thought that probably these factors produce a deterrent to tussive squeeze or collapse phenomena of the intrapulmonary tissues.

In our experience we have observed that central lung abscesses heal better than do those in the periphery of the lung. What are the

reasons for this clinical observation? We have thought of three factors as being contributory. On the basis of physics there is more tussive squeeze, better drainage and the lesion is more easily approachable bronchoscopically in the centrally placed abscesses than in the peripheral ones.

By a reference to the remarks on the location or site of lung abscess, it will be noted that the lower lobes were more frequently involved. Again the question occurred: Why the larger percentage of abscesses in the lower pulmonary lobes? It would seem that this is partly dependent upon mechanics, especially where the aspiration method has been the channel of ingress of the offending etiologic factor. In our review of the literature, we saw no series of cases analyzing the embolic and aspirational factors as relating to the involvement of the various pulmonary lobes. It occurs to us that such an analysis might show the aspirational preponderance in involvement of the lower lobes with a restriction largely to embolic phenomena where the upper lobes are concerned.

EMPIRE BANK BUILDING.

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LXXII

THE DEVELOPMENTAL MECHANISM OF PULMONARY ATELECTASIS*

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Pulmonary atelectasis was first described by Legendre and Bailey (1844),[1] who ascribed the condition both to bronchial obstruction and to ineffectual respiratory movements. Mendelssohn (1844),[2] Traube (1846)[3] and Lichtheim (1879),[4] with a succession of other investigators since then, have established bronchial plugging as one of the causes of atelectasis. W. Pasteur (1908)[5] added to the importance of the condition by calling attention to the incidence of atelectasis of one or more lobes of the lungs following operative procedures, and he suggested a neurogenic origin of such pulmonary conditions (1914).[6] Lee (1924)[7] agreed with Legendre and Bailey that two factors are responsible: interference with respiratory movements and bronchial obstruction. On the other hand, the investigations of Coryllos and Birnbaum (1928)[8] led them to believe that bronchial obstruction constitutes the only factor in atelectasis, all the other elements being merely predisposing. Other causes which were suggested, such as diaphragmatic paralysis, inhibitory respiratory reflex, reflex contraction of the bronchial muscle or ball valve action of an obstructing bronchial plug, eventually resolve themselves into either of the two basic states: bronchial obstruction or ineffectual respiration.

It is our experience, as well as of other observers, to find at the autopsy well-defined pulmonary atelectasis of one or more lobes without presence of foreign bodies. Coryllos and Birnbaum[8] explain such findings by assuming that obstruction need only be temporary to induce atelectasis. Such a postulate requires further corroboration.

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The work done on bronchial obstruction and pulmonary gas exchange has considerably clarified the general picture of pulmonary atelectasis. Further investigations, however, are necessary both of the individual problems as well as of corroborating the factual findings already recorded. The work presented here is experimental and was done to investigate the relationship of bronchial obstruction to pulmonary atelectasis.

COMPLETE BRONCHIAL OBSTRUCTION

The experiments were performed on a series of 30 dogs under pentobarbital anesthesia. The obstructing material consisted of pieces of rubber bath sponge 2 x 4 cm. which were compressed and introduced into a bronchus through a bronchoscope. When in situ, the sponge expanded, producing complete blocking with a minimum of damage to the bronchial mucosa. Attempts of obstruction with metal buttons and balls were unsatisfactory, because they caused bronchial ulceration and were too frequently expelled. Introduction of iodized oil into the bronchus with a subsequent roentgenogram failed to show leakage of the oil past the obstructing sponge plug, indicating, within the limits of the test, the complete occlusion of the bronchial lumen. The dogs were killed at intervals from 30 minutes to 13 days. Frequent chest roentgenograms were taken of the living animals. Sections for microscopic study were removed from the obstructed and normal lung and from normal and plugged bronchi. Prior to the death of the animals, the pulmonary circulation was visualized by the injection of iodized oil into the right jugular vein. In some of the dogs the bronchial circulation was injected with iodized oil as described by Steinberg and Mundy.[10] The animals were killed within two minutes after the introduction of the iodized oil and the roentgenograms were taken within fifteen minutes. Delay either in the death of the animal or in taking of the roentgenogram resulted in diffusion of the oil and a consequent blurring of detail.

The gradual changes observed grossly and microscopically, and as visualized with the roentgenograms, will be described individually and then correlated. Grossly, there appeared in the second hour an alteration of the normal pink color in the obstructed lung to a dusky purple-red. The color changes extended from the periphery. There was also a lessening of the usual tissue crepitation. The bronchial mucosa at and surrounding the area of obstruction was injected. The next change in appearance was observed on the 6th to the 7th hour, with an apparent increase in the size of the obstructed lung, and with an increase in crepitation. This condition continued through

Fig. 1. Gross photograph of dog lungs with a plug completely obstructing the bronchus for one day. The lobe is atelectatic.

to the 14th hour. A mucopurulent material was found in the bronchi on the 7th hour, the greater accumulation being distal to the obstructing plug. In the early hours (from 7th to 14th) bacteria were only present distal to the occlusion. In the later hours, bacteria were found throughout the bronchus. There was also a mucopurulent material in the bronchi adjoining the obstructed one, but to a lesser degree. In the 20th hour the color of the obstructed lung was a red-purple and the organ was of a dry, leathery consistency. At the end of 24 hours the purple-red, dry, leathery state of atelectasis involved the entire obstructed lung. After that hour the edema became more extensive, with a change of color to a deep red. The tissue consistency became softer and slightly soggy. The cut surface exuded, upon pressure, yellow purulent material. On the third day the edema involved the entire obstructed lung. The cut surface

Fig. 2. Gross photograph of dog lungs with a plug completely obstructing the bronchus for two days. The involved lobe shows edema and pneumonitis. Note the change in appearance of involved lobe from that in Fig. 1.

exuded purulent material from bronchi and the parenchyma. On the fourth day there were obvious parenchymatous abscesses which increased in number and size on succeeding days. The obstructed lung at this time completely lost the original picture of the dry, purple-red atelectasis and was replaced by a soggy, edematous, yellow-red abscess ridden lung. On the thirteenth day there were large necrotic areas. It was only an occasional animal that survived to that stage.

Microscopically the tissue changes became apparent earlier. Within half an hour the interstitial blood vessels were moderately dilated and filled with blood. The alveoli showed no apparent decrease in size. The lumina of the bronchi contained mucous secretion

and a slight mononuclear infiltration was present in the serosal layer of the bronchial wall. At the end of the first hour there appeared patches of atelectasis (completely collapsed alveolar walls and hyperemia of interstitial tissue). The bronchi contained more mucus than at the half-hour period. In 2 hours the atelectatic patches increased in extent and number. On the 7th hour emphysematous patches (dilated and intercommunicating alveoli) appeared. The atelectatic areas were not as prominent. This condition persisted with varying degrees of atelectasis and emphysema through to the 14th hour, at which time the atelectasis was rather extensive but still patchy in character. By the 20th hour the atelectasis was diffuse and complete. The bronchi were filled completely with polymorphonuclears. On the 24th hour polymorphonuclears were found in small numbers within alveoli and in the interstitial tissue. By the 48th hour the inflammatory exudate of polymorphonuclears was diffuse and marked (pneumonitis). The alveoli showed presence of fluid (edema). On the third day the edema was more extensive and the leucocytes began to congregate in individual areas (early abscess) with evidences of degenerative nuclear changes. On the fourth day obvious abscesses appeared. The pathological changes described progressed in extent up to the ninth and to the thirteenth day, at which time there appeared extensive necrotic patches.

Interpretations of flat plates of the animal chests, with an occasional stereoscopic view, failed to reveal any changes up to the 24th hour. A diagnosis of atelectasis was made at that time and the interpretation of the roentgenograms on succeeding days (to the 13th) remained one of atelectasis.

The pulmonary arterial tree as outlined by iodized oil was studied from one-half hour to thirteen days after bronchial obstruction was produced. Changes in the arterial tree were apparent in two hours and consisted of a loss of outline at the periphery of the obstructed lung. In the succeeding hours the pulmonary arteries showed more extensive filling defects affecting the smaller, and in some instances, the larger vessels. It was apparent that the iodized oil was prevented from reaching the smaller pulmonary arteries.

The bronchial circulation was injected with iodized oil in the early hours, in twenty hours and in three days and seven days after the bronchi were plugged. The bronchial circulation was visualized very slightly (normal) until there was complete atelectasis and pneumonitis in the obstructed lung. At that time (slightly in 24 hours and more pronounced on the third day) the arteries became apparent, due to the dilation of the vessel lumena.

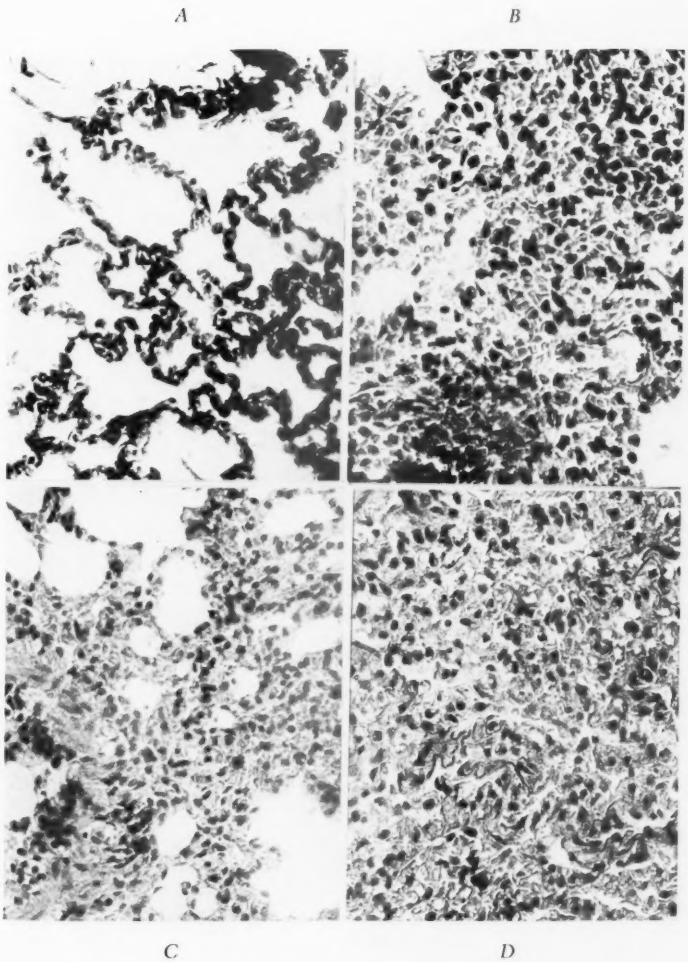


Fig. 3. Microscopy of the progressive atelectatic process:

A. Microscopic section of involved lung one-half hour after complete bronchial obstruction. Hyperemia of the interstitial tissue.

B. Microscopic section of involved lung two hours after complete bronchial obstruction. Marked interstitial hyperemia and patchy atelectasis.

C. Microscopic section of involved lung fourteen hours after complete bronchial obstruction. Patchy atelectasis.

D. Microscopic section of involved lung twenty hours after complete bronchial obstruction. Diffuse atelectasis.

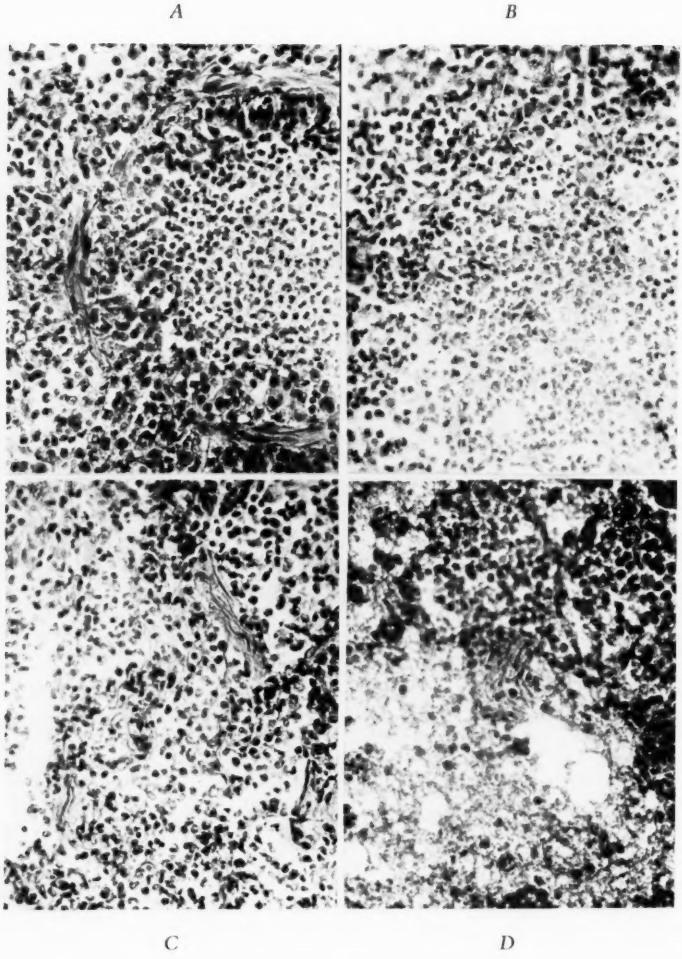


Fig. 4. Microscopy of the progressive infectious process.

A. Microscopic section of an involved bronchus and surrounding lung twenty hours after complete bronchial obstruction. There is a polymorphonuclear exudate within the bronchial lumen and in the surrounding lung tissue.

B. Microscopic section of an involved lung two days after complete bronchial obstruction. There is a diffuse polymorphonuclear exudation involving the alveoli and the interstitial tissue.

C. Microscopic section of an involved lung four days after complete bronchial obstruction. There is destruction of tissue and polymorphonuclear infiltration.

D. Microscopic section of an involved lung thirteen days after complete bronchial obstruction. There is necrosis of tissue.

TABLE I

CORRELATION OF GROSS, MICROSCOPIC AND ROENTGEN RAY FINDINGS ON LUNGS WITH A COMPLETELY OBSTRUCTED BRONCHUS

Time of Observation	Gross Diagnosis of Lung Condition	Microscopic Diagnosis of Lung Condition	Roentgen Ray Diagnosis of Lung Condition on Flat Plate	Roentgen Ray Diagnosis of Pulmonary Circulation	Roentgen Ray Diagnosis of Bronchial Circulation
½ hr.	Nothing apparent.	Interstitial hyperemia.	Nothing apparent.	Nothing apparent.	Nothing apparent.
1 hr.	Nothing apparent.	Patchy atelectasis.	Nothing apparent.	Nothing apparent.	Nothing apparent.
2 hrs.	Patchy early atelectasis at lung periphery.	Extensive patchy atelectasis.	Nothing apparent.	Loss of outline of pulmonary arteries at periphery of lung.	Nothing apparent.
3 to 5 hrs.	Same as 2nd hour	Same as 2nd hour.	Nothing apparent.	More pronounced.	Nothing apparent.
7 to 14th hr.	Emphysematous and atelectatic patches.	Ephysematous patches alternating with atelectasis.	Nothing apparent.	More pronounced and involvement of vessels away from periphery	Nothing apparent.
20 hrs.	Complete and diffuse atelectasis.	Complete and diffuse atelectasis. Purulent bronchitis.	Nothing apparent.	Loss of outline of small and medium sized vessels.	Nothing apparent.
24 hrs.	Diffuse atelectasis and early edema	Atelectasis and early diffuse pneumonitis and edema.	Atelectasis.	Same as 20th hr.	Slight visualization of bronchial arteries.
2nd day	Moderate edema and diffuse atelectasis.	Marked pneumonitis and edema.	Atelectasis.	Same as 20th hr.	Same as 24th hr.
3rd day	Atelectasis, pneumonitis and edema.	Extensive edema and early abscess formation.	Atelectasis.	Same as 20th hr.	Moderate visualization of bronchial arteries.
4th day	Abscess formation, atelectasis and pneumonitis.	Multiple abscess formation.	Atelectasis.	Same as 20th hr.	Same as 3rd day.
5 to 13 days	Same as 4th day.	Same as 4th day.	Atelectasis.	Same as 20th hr.	Same as 3rd day.
13th day	Patchy necrosis.	Patchy necrosis.	Atelectasis.	Same as 20th hr.	Same as 3rd day.

INCOMPLETE BRONCHIAL OBSTRUCTION

Several questions arise as a result of the experiments so far presented. The first question concerns the relationship of atelectasis to the anteceding, concommitant and succeeding lung changes. Do the abnormalities observed constitute a part of the atelectatic picture? What is the relation of a complete bronchial obstruction to atelectasis? The fact that atelectasis is associated with bronchial obstruction may not necessarily indicate a causative relationship. Is the mere presence of a plug, irrespective of the degree of obstruction, responsible for atelectasis, or is a complete closure of the bronchial lumen an essential requirement of an atelectatic state?

The following procedure was devised in an attempt to clarify to some extent some of these questions. A metal tube was cemented into the approximate center of one of the rubber plugs previously described and introduced with a bronchoscope into the bronchus (most frequently main right) of twenty dogs. The animals were killed at intervals between one-half hour and thirteen days. Prior to the death of the animal, either the pulmonary or the bronchial circulation was injected with iodized oil and the animals were killed within two minutes. Roentgenograms were taken at daily intervals of the animals' chests.

Grossly, the lungs with partially obstructed bronchi showed in eight hours an hyperemia of the cut surface and in twenty-four hours there was mucopurulent material in the bronchi (distal to the plug) with a slight change in color of the parenchyma to a deeper red. On the third day the cut surface had dry patches of red-gray, which became more prominent on the fourth day. Thereafter, and up to the thirteenth day, the patches were less in number and the remaining ones were of a beefy red. There was no evidence of atelectasis.

Microscopically there was slight hyperemia in the fifth hour and a slight pneumonitis in the eighth hour. At the end of one day the hyperemia became more marked, the pneumonitis was more extensive, with a greater number of inflammatory cells. On the succeeding seven days the involved lung began to resemble a human bronchopneumonia. The alveoli were filled with polymorphonuclears, fibrin was practically absent. The bronchi contained within the lumina numerous polymorphonuclears which also infiltrated the bronchial walls. On the seventh day the inflammatory cells were considerably reduced in number both in the alveoli and in the bronchi, being replaced by alveolar, bronchial epithelial cells and young fibroblasts. The hyperemia persisted. Except for an increase in fibroblasts, the

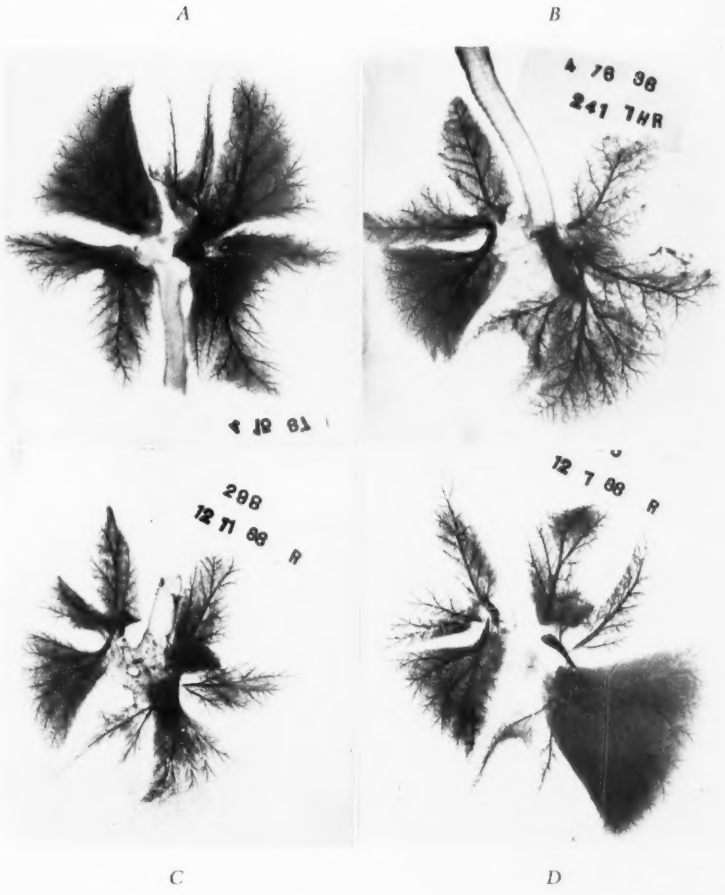


Fig. 5. Roentgenograms of the progressive stages of pulmonary atelectasis associated with complete bronchial obstruction.

A. One hour after obstruction, with slight lack of visualization of the pulmonary arterial branches at the periphery.

B. Seven hours after obstruction, with more pronounced lack of visualization of peripheral pulmonary arterial tree. There are no other apparent changes. However, grossly and microscopically there were patches of atelectasis.

C. Twenty hours after obstruction. Pronounced lack of visualization of the pulmonary arterial tree throughout the lung. There is a slight density of the proximal half of the involved lung. Compare the pulmonary circulation between the involved and the uninvolved lobes. Grossly and microscopically there was a diffuse atelectasis of the entire lobe.

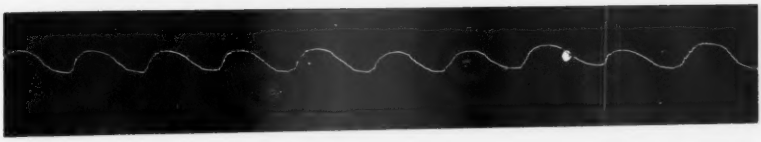
D. Four days after obstruction, with lack of visualization of the smaller pulmonary vessels. Compare with the normal lobes. The involved lung shows a diffuse density interpreted as atelectasis. Grossly and microscopically there was marked edema, pneumonitis and abscess formation.

Fig. 6. Roentgenograms of the partly obstructed lung.

A Note the metal tube through the sponge. Twenty-four hours after incomplete obstruction. No disturbance of the pulmonary arteries. Lung parenchyma appears normal. Grossly and microscopically there was a purulent bronchitis and patchy inflammation of the bronchopneumonia type.

B. Seven days after incomplete obstruction. No abnormal changes either in the pulmonary circulation or lung parenchyma. Grossly and microscopically there was a moderate degree of bronchitis and inflammation, of bronchopneumonic nature, with slight diffuse fibrosis. Compare with roentgenograms in Fig. 5 showing complete bronchial obstruction.

Tracing 1



Tracing 2

Fig. 7. Tracings of lung movements of a completely obstructed bronchus and of a normal lung showing the interference with the respiratory movement of the involved lobe. Tracing 1 represents the respiratory movement of a lobe with patent bronchi. Tracing 2 is of a lobe with completely obstructed bronchus.

microscopic picture remained unchanged on the thirteenth day. Only an occasional animal retained the plug up to the thirteenth day.

The flat roentgen plates of the chests, as well as the roentgenograms of the pulmonary and bronchial circulation with iodized oil, failed to reveal any abnormalities.

It was obvious that incomplete bronchial plugging did not result in pulmonary atelectasis, but did produce a bronchitis and inflammation of the lung parenchyma differing in degree and in nature from that observed in completely obstructed bronchi.

ATELECTASIS IN OPEN CHEST EXPERIMENTS

Since only complete bronchial obstruction resulted in atelectasis, it was considered apparent that the condition was due to the failure of the lung to inflate. In the light of observations of other investigators (Legendre and Bailey, Pasteur, Lee and others) that bronchial obstruction is not the only factor that produces atelectasis, but interference with respiratory movements may also accomplish the same results, the following experiment was performed in an attempt to evaluate that concept.

A tube, connected with an artificial respirator, was introduced into the right main bronchus of a dog under pentobarbital anesthesia. A window was cut out in the chest wall in order to observe the lungs. The right lung received artificial respiration through the tube. The left lung was not aerated. In one hour the periphery of the nonaerated lung showed a change of color to a purple-red. In five and one-half hours the entire left lung was a purple-red and leathery in consistency—a definite gross picture of atelectasis. Microscopically the nonaerated lung showed interstitial hyperemia, collapse of alveoli and presence of secretory material in the bronchial lumina. The artificially aerated lung was normal both grossly and microscopically.

Obviously such an experiment is an exaggeration, but it demonstrates that an atelectatic state can be produced in the presence of a serious interference with the respiratory movements and without bronchial obstruction. It is irrelevant to the question considered if the atelectasis resulting from an absence of respiratory movement was due to removal of the negative intrathoracic pressure. This experiment suggests that any such interference with respirations, irrespective of the mechanism, may result in atelectasis.

In order to determine the comparative pictures of the lungs with completely obstructed bronchi in closed and open chests, five dogs were placed under pentobarbital anesthesia and the right main bronchus was either completely obstructed with a sponge or tied with a silk ligature. Windows were cut out in the chests of each of the animals for observation of the lungs. The trachea was connected with a tube to an artificial respirator.

In fifteen minutes there was a slight diffuse cyanosis of the obstructed lung. In three hours the lung periphery became purple-red and leathery. In seven hours the entire lung was purple-red and leathery—a picture of complete atelectasis. There was only slight variation in time of appearance of the abnormal change in the individual animals with either obstructed or tied bronchi.

RELATION OF TEMPORARY OBSTRUCTION TO ATELECTASIS

The right main bronchus of six dogs was completely obstructed with sponges. The plugs were removed at intervals of eight hours, one, two, three and four days, and the animals were then killed on the following day. The sixth dog expelled the sponge some time between twelve and eighteen hours. The animals with obstructed bronchi for eight hours, twelve to eighteen hours and one day showed no evidence of atelectasis. The other dogs, with obstruction for two,

Fig. 8. Roentgenogram of lungs in an open chest experiment five and one-half hours after onset of experiment. Right lung with artificial respiration. There are no abnormal changes. The left lung was not aerated. Note the lack of visualization of the pulmonary arteries, especially at the periphetry, and lack of density in the lung parenchyma. Grossly and microscopically there was a diffuse atelestasis.

three and four days, revealed the usual picture of pneumonitis and abscess formation.

Chest windows were excised in two dogs under pentobarbital anesthesia. The right bronchus of one was completely plugged with a sponge. A silk ligature was placed around the right bronchus of the other dog. After a period of seven to nine hours, when complete atelectasis of the obstructed lungs was apparent grossly, the plug and the ligature were removed from the bronchus of the two dogs.

The atelectatic lungs returned to a normal salmon pink within one to two minutes.

Sponge plugs were introduced into the right bronchus in a series of five dogs. The plugs were removed on the second, third, fourth, fifth and sixth days, respectively. The animals were killed five days after the removal of the plugs. Grossly and microscopically the lungs showed pneumonitis and abscess formation which did not differ from the picture of those dogs with a continuous bronchial obstruction.

SUMMARY AND DISCUSSION

The underlying basis of pulmonary atelectasis, as demonstrated under the conditions of our experiments, is a serious interference with the respiratory movements of the lung. This interference may be accomplished by many means. Complete bronchial obstruction is only one of the causes and the atelectasis so produced is apparently due to the interference with respiratory movements. Temporary, although complete, occlusion of a bronchus does not lead to atelectasis (as maintained by Coryllos and Birnbaum[8] and contradicted by our experiment in which the lung returned to normal in a few minutes after removal of the plug) unless the obstructing material has been in the bronchus for a sufficiently long period to induce pulmonary edema and pneumonitis. In the dog this time period of occlusion is one day.

There is a definite anatomical sequence of events in atelectasis as observed under the conditions of our experiments. The first change is a stasis of the pulmonary arterial circulation starting at the periphery of the lung. It is quite possible, although our experiments do not include this phase, that the venous and the capillary system are likewise involved in the stasis. This stasis has been determined by the study of microscopic sections and by visualization in the lungs injected with iodized oil. The failure to observe the arterial stasis by Coryllos and Birnbaum[9] is probably due to the fact that these investigators failed to take roentgenograms of the lung specimens promptly enough and likely allowed a slow diffusion of the iodized oil into the blood filled vessels. Our experiments concur, however, with the final view expressed by the later investigators that proper pulmonary ventilation is necessary for normal pulmonary circulation.

Patchy atelectasis follows pulmonary stasis. The complete involvement of the lung in our animals was found to appear in several hours (from 5½ to 24), depending upon the mechanism responsible for atelectasis. It may be deduced that the greater the interference

with the respiratory movements, the more rapid is the alveolar collapse. The experiments here reported do not concern themselves with the probable mechanisms by which the air leaves the alveoli; absorption by the blood vessels or escape through the bronchi. However, some of our findings may bear an indirect relation on this phase of the problem. The first appearance of atelectasis at the periphery and away from the larger bronchi and the production of atelectasis due to a complete plugging of a bronchus (as demonstrated by failure of iodized oil to trickle through the obstruction) would point to the absorption of air by the blood vessels. The assumption of a ball valve action of the obstructing plug, which allows the air to pass out, is not applicable to the type of sponge plug used in our experiments. On the other hand, the rapidity of loss of air which parallels the severity of the respiratory interference (not due to bronchial obstruction) and the consequent pulmonary arterial stasis must be explained if the air absorption theory is maintained as the sole one. An explanation has been advanced by Van Allen, Lindskog and Richter,[11 12] who maintain the existence of a collateral respiration with intercommunication between the lobular divisions of the lobular tree. Unless the main bronchus is obstructed, air may escape through the intercommunicating bronchi.

Even before atelectasis is established completely throughout the involved lung, a superimposed infectious process appears. The infection is first apparent in the bronchi as an acute purulent bronchitis. In a few hours a diffuse cellular infiltration invades the alveoli and the interstitium. The appearance of this pneumonitis may be assumed to be either an extension of the bronchial infection or an independent process. In incomplete bronchial obstruction there is no atelectasis, but an infectious state is present. This inflammatory process with incomplete bronchial obstruction, however, resembles that of human bronchopneumonia, and therefore differs from the pneumonitis associated with atelectasis. The two inflammatory processes (in complete bronchial obstruction with atelectasis and in incomplete bronchial obstruction) also differ in the severity and in the eventful outcome of the infection. On the basis of these findings, it may be assumed that pulmonary atelectasis, as produced under the conditions of our experiments, is associated in its later stages with an infectious process of a diffuse character (pneumonitis), terminating in abscess formation and tissue necrosis.

The interpretation of the roentgenograms taken of the chests of the animals indicates that a diagnosis of atelectasis is not possible until the entire lung or lobe is involved and some edema and pneumo-

nitis is superimposed. The roentgenogram interpretation made no differentiation between atelectasis, slight edema and pneumonitis, or marked pneumonitis and abscess formation. A diagnosis of atelectasis was made invariably, irrespective of the state of infection resident in the lungs.

If removal of the bronchial plug or ligature was accomplished before the onset of a fairly well advanced edema and pneumonitis, the lungs returned to normal. With forceful ventilation, atelectasis disappeared within a few minutes. However, in the presence of pneumonitis, even though the bronchial obstruction was removed, there was an obvious failure of the lung to resume its normal appearance, even after several days.

CONCLUSIONS

1. Pulmonary atelectasis can be produced under the conditions of our experiments by serious interference with respiratory movements (inflation and deflation of lungs). Bronchial obstruction is only one of the mechanisms responsible for atelectasis.

2. A definite series of successive events occurs when atelectasis is produced under the conditions of our experiments. An initial stasis of the pulmonary arteries followed by patchy, then diffuse atelectasis and eventually by edema and pneumonitis, abscess formation and necrosis was demonstrated by experiments.

3. Partial bronchial obstruction results in an infectious state resembling human bronchopneumonia, but not in atelectasis, because there is preservation of the respiratory movements permitting inflation and deflation. Removal of the cause of the atelectasis prior to development of edema and pneumonitis allows the return of the lungs to a normal state. The return to normal may be accelerated by artificial respiration.

4. It may be deduced from the above experiments that the basic cause of pulmonary atelectasis is interference with respiratory movements (inflation and deflation of lung). It is apparent that many causes may produce such interference.

NOTE: We are indebted to Dr. Murray E. Goodrich for his interpretation of the roentgen films.

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LXXIII

DIAGNOSIS AND TREATMENT OF PRIMARY BRONCHIAL CARCINOMA*†

WAITMAN F. ZINN, M.D.

BALTIMORE

The statement that primary carcinoma of the bronchi is on the increase is heard today on every hand. On casual examination it seems a plain fact, simply stated. Within the past fifty years the increase has been about tenfold.[3] Pathologic and medical textbooks of a decade ago stated that carcinoma of the lung constituted about 1 per cent of all carcinomas, while today we know that they comprise at least 10 to 12 per cent of all cancers.[1] Therefore, the conclusion that there is an increase in the disease seems to be well founded.

I feel, however, with a number of others, that there is more to consider than appears at first glance; that for a number of reasons, which I shall briefly point out, we have cause to rejoice that improved facilities and technic have roused the awareness of both medical men and laity to such an extent that an increase in diagnosis of bronchiogenic carcinoma may well mean an increase in cures.

In comparing the early work done on carcinoma of the lung with that of today, it is well to remember that in most cases the diagnosis was made at postmortem. The number of postmortems obtained in unusual cases was comparatively low. Also, if there were present any other more easily recognizable conditions or diseases, the one in which we are now most interested was frequently overlooked. Thus the number of bronchiogenic carcinomas reported was lessened on two counts. Likewise, diagnoses obtained in late stages of the disease frequently were as confused as those obtained at postmortems, by the secondary involvements assuming primary aspects and proportions.

Secondly, the increased knowledge of other pulmonary conditions, such as tuberculosis, lung abscess, bronchiectasis, etc., has tended to make possible the ruling out of these diseases early in the case and has aided concentration on the real disease by early diagnosis.

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*Read before the Twentieth Annual Meeting of the American Bronchoscopic Society at Atlantic City, June 2, 1937.

†From the Waitman F. Zinn Bronchoscopic Clinic, Mercy Hospital, Baltimore.

Thus, cases which were once classed as tuberculosis, or perhaps lung abscess, are now recognized as bronchiogenic carcinoma and the latter classification tends thus to be increased.

Another hypothesis frequently advanced for the apparent increase in bronchiogenic carcinoma is that environment—the civilization in which we live today—is a predisposing factor etiologically toward the condition. The question of the effect of certain dusts, of tar and of cigarette smoke is brought up. But as yet no one factor has presented enough evidence to be pronounced the cause per se. The probable truth is that, as with cancer elsewhere in the body, a combination of factors met by a variety of irritants tends to produce the disease in different individuals.

By far the greatest reason for the seeming increase in carcinoma of the lung in recent years is the development of cöoperation between internist, radiologist, bronchoscopist, clinical pathologist and thoracic surgeon in the treatment of these cases. Teamwork between these departments will mean the real salvation of these patients and the solution of the problems presented by the apparent upward trend in the disease.

The rapid development of diagnostic means pertaining to lung lesions has made it possible to save a large number of patients who otherwise would have been doomed to death. The importance of a careful examination early in the case cannot be too strongly urged. Late or hasty examinations often mean failure. As with malignancy of other parts of the body, the early symptoms are often slight and the condition is overlooked until the disease has progressed beyond the possibility of a cure, leaving palliative measures as the only recourse. The most constant symptom in our series has been the cough, varying in degree from mildness to severity. The sputum may or may not be blood tinged. Pain in the chest may be present but is not so constant a sign. Cough with an occasional rise of temperature has been present in nearly all cases.

X-ray is of the greatest value in diagnosis. While the diagnosis is not positive in all cases, I have found it so in about 80 per cent of our series. In any case of suspected lung tumor, no treatment should be given until a thorough study and a positive diagnosis is made. As pointed out earlier, a delay may mean failure, for, since there is practically always a secondary infection, palliative treatment will relieve the symptoms for the time while the growth continues to invade the lung tissue. The age of the patient should not weigh too heavily in the decision, for the methods of today make possible the detection of the disease in earlier years.

Atelectasis of a lobe of the lung is always suspicious of bronchial tumor and should be so considered until positively determined otherwise. We should keep in mind that a prolonged case of lung suppuration may produce a benign constriction accompanied by atelectasis. It is difficult, frequently, to outline a tumor by x-ray, as to size, because the shadow produced by atelectasis may give the idea of a large mass, whereas the tumor itself may be quite small and producing a complete blocking of the bronchus. When it is not thus possible to demonstrate bronchiogenic tumor by x-ray or bronchoscopy an injection of lipiodol is a valuable aid in helping to clear up the location of the mass and the diagnosis.

While bronchoscopy does not determine the extent of the lesion, it definitely establishes a positive diagnosis and the location of the growth, and it aids the surgeon in selecting the cases which are thought to be best suited for operation. A negative bronchoscopy or biopsy should not exclude the possibility of malignancy. I have often found it necessary to do a second bronchoscopy for biopsy, for I frequently find conditions are such at the first examination that it is not wise to take a specimen for biopsy.

The citation of a few cases will help to illustrate the points I have been making. One recent patient is a white male (it will be noted that a preponderance of cases is found among males), whose age is 52 years. Statistics show that the greatest number of cases occur between the ages of 40 and 60. Our patient gives a vague history of some slight injury to the chest about ten years ago. This was followed "some time afterward" by a slight, irritating, nonproductive cough. The cough did not bother him a great deal, but persisted and tended to become paroxysmal in nature. It would not yield to ordinary treatment, and was unexplainable clinically on the basis of any other existing conditions. Gradually the patient developed a feeling of discomfort in his right side, noticed that he was losing weight and tired easily; dyspnea was present on slight exertion and he began expectoration of mucus occasionally blood streaked. Physical examination by the internist is essentially negative except for the chest, where dullness, râles and diminished breath sounds on the right side, anteriorly and posteriorly, are noted. Family history is negative and likewise the laboratory findings.

X-ray of this patient is ordered and the report shows an atelectasis of the upper right lobe. Injection of lipiodol through an inserted catheter followed by x-ray made possible the diagnosis of obstruction of the bronchus of the right upper lobe. Bronchoscopy for biopsy is advised. Let me again emphasize that once the tentative

diagnosis of bronchial tumor is made, it is imperative that there be a biopsy taken at once to confirm the diagnosis. The failure to recognize the advantage of direct inspection and biopsy is responsible for the loss of many cases. We do not claim that bronchoscopy is free of danger and a very simple means of getting the desired information concerning a most inaccessible region. Hemorrhage and brain embolus, dreaded complications in other lung diseases, are not strangers to the field of bronchoscopy. But if undertaken with care and by an expert, bronchoscopy is no more dangerous than other exploratory operations in other regions.

Bronchoscopy revealed, in the patient we are considering, a partial occlusion of the lumen of the right main bronchus by a mass from which a specimen was secured. The pathologic report was bronchiogenic carcinoma. Since the tumor seemed to be fairly well confined to one lobe, it was thought advisable to perform a lobectomy, the technic of which will be discussed later by my collaborator, Dr. Rienhoff.

In another case, a young man, 33 years of age, reported three attacks of so-called la grippe the previous six months. There was a slight cough between attacks, otherwise no symptoms and no loss of weight. X-ray suggested unresolved pneumonia at the left base. Bronchoscopy revealed a mass in the lower left bronchus partially obstructing the lumen and producing an atelectasis. The secretion present was caused by a secondary infection. Biopsy returned a diagnosis of bronchiogenic adenocarcinoma.

Another patient, a woman, 35 years of age, was referred to the clinic with a history of sudden onset of symptoms, cough and expectoration of bloody mucus. There was some dullness at the base of the right lung. X-ray suggested bronchial obstruction and foreign body was considered. Bronchoscopy revealed a large mass in the right lower bronchus, causing obstruction, and biopsy gave a diagnosis of adenocarcinoma. The patient died following a pneumonectomy, and autopsy showed the growth to be much more extensive than was expected from the history and bronchoscopic findings.

The quesion of selecting the type of treatment, after diagnosis is made, is an important one. I feel that if the growth, from an endoscopic point of view, is located in such a position that a lobectomy or pneumonectomy will remove it, that is the procedure of choice, provided, of course, that the physical condition of the patient, from a medical point of view, will permit it. Otherwise, the use of radium or deep x-ray therapy is recommended. The mortality in thoracic surgery is higher than that in other fields. But experience has shown

that, the condition of the patient permitting, we have obtained the best results by means of surgery.

The facts I have attempted to bring out in this paper are not new ones, but they still need repeating. The crying need in the diagnosis and treatment of carcinoma of the lung is the early recognition of the disease and its elimination before it gets a foothold. The rapid strides being made in thoracic surgery make it possible to cure many cases. Bronchoscopy holds a great place in the field of diagnosis of lung conditions, as it is the only means by which a positive proof can be obtained before the final stages of the disease.

SUMMARY

Early diagnosis, so essential for favorable outcome in bronchiogenic carcinoma, can be made only by means of cöoperation between internist, radiologist, bronchoscopist, clinical pathologist and thoracic surgeon.

Bronchoscopy with biopsy is the only positive means of final diagnosis.

Treament consists of two methods: radiotherapy (for those cases unsuited to operation) and surgery.

MEDICAL ARTS BUILDING.

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Society Proceedings

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Meeting of Monday, March 1, 1937

THE PRESIDENT, DR. IRA FRANK, IN THE CHAIR

Oto-Laryngological Division—Army Medical Museum

DR. JOSEPH C. BECK: Earlier in the evening we exhibited here a loan set of histopathologic preparations which was sent to me from the Army Medical Museum in Washington. I thought I would bring them here and show them to you so you could see what can be obtained, if anyone is interested.

Two years ago this oto-laryngological division of the Registry was started, and since then they have made fifty-one preparations of otolaryngological histopathology, of which they have twenty-five sets. They expect to complete the sets to one hundred preparations in due time. Accompanying each set is an atlas with the gross preparations, indicating just what these slides are, and then there is a write-up on these preparations telling just what can be seen under the microscope.

The loan sets may be had through the Curator of the Army Medical Museum, Major James E. Ash, by writing to him and sending with the request a check of $25.00 as a deposit. On the return of this set, after three weeks, this money is returned, minus the cost of shipment. If a preparation is broken or lost during the loan there will be a charge of $1.00 per preparation.

During the next three months these twenty-five sets of fifty-one preparations will not be available except for the candidates for the next examination by the Otolaryngological Board and giving each man three weeks use of a set with the literature, including the time of sending, will take about a month. After that time the sets may be had by any member of the Academy. You will remember that the American Academy of Ophthalmology and Otolaryngology is sponsoring this section at the Army Medical Museum under the direction of the Surgeon-General.

I also wish to show you a chart which may be obtained which indicates the preparations we are anxious to get at the Museum. Any gross preparation which you may have of ear, nose and throat specimens will be examined for you free of charge if you will send them to the Museum, and a slide will be returned to you with a description of the findings. We are very anxious to obtain these specimens that are indicated on the questionnaire, and the chart tells you how you should send a preparation to Washington so it will reach there in good order so it may be properly prepared.

It must further be remembered that the Registry in nowise promises to return the preparation at any definite time and is not in competition with commercial or other business organizations.

Any member of the Academy, or any otolaryngologist who has a member of the Academy sponsor him, can obtain the loan of these sets.

DR. AUSTIN A. HAYDEN: I wish to remind you that Dr. Beck is very largely responsible for the creation of the opportunity which is placed in the hands of over 1500 otolaryngologists in this country to have pathologic slides in their own hands for study. Dr. Beck did not say so, but I think we of Chicago should know that he has been instrumental in doing this, and that we, as well as others, will benefit by this effort. I am a great believer in giving the flowers now, Dr. Beck.

Comments on Sinus Treatment

ARTHUR W. PROETZ, ST. LOUIS

(Author's Abstract)

As the first step, the normal functions of the nose should be considered. As a second, the deviations from the normal should be evaluated in terms of discomfort and injury to the patient, and also in terms of the likelihood of their correction. With this information at hand, it should be possible to select methods which will accomplish most and injure least.

Both inspired and expired air pass through the normal nose in a high, vaulted curve, the inspired passing largely through the olfactory fissure, the expired partly through the middle meatus as well. Except for certain eddies which have been described elsewhere, the currents are much the same.

This is not true, however, of the pressures. The extent of the fluctuation is determined largely by the relative size of the naris, and in abnormal noses by the size and location of any obstruction. The

greater the obstruction anteriorly, the greater the fluctuation. Naturally posterior obstructions have the opposite effect. Peak pressures in normal sinuses equal those within the nasal chambers.

Distribution is extremely important. In order properly to temper the inspired air, a large proportion of the mucosa must come into play. If the total volume of air is forced to pass through a restricted channel or channels, these cannot cope with the requirements. The result is overdrying in the exposed areas and overmoistening in the protected ones.

The mucous blanket is perhaps the most important single factor in the prevention and eradication of nasal infection. It is a thin but tough and viscous secretion. It is entirely renewed once every half hour. This refers to the normal nose; disease conditions impede or even prevent its flow. Anyone who has observed living cilia in action must be impressed with the importance of this mechanism. Investigators are agreed that the maintenance of the proper moisture and viscosity are vital to its effectiveness.

Cilia are vigorous and resistant, and extremely powerful in proportion to their size. Their activity is difficult to suppress; even severe cold (5° C.) only suspends their activity, and they revive on rewarming; they live for hours after the death of the individual, even though the body is kept in a refrigerator; they persist for days in Locke's solution under the microscope. They are regenerated, together with the epithelium, after complete stripping of a sinus wall; they commonly persist within sinuses in the presence of old and extensive purulent infections.

The one requisite to their existence throughout the animal world is adequate moisture. In the planning of nasal surgery, therefore, nothing is so important for drainage as an avoidance of dry areas.

The air exchange in a sinus is extremely small—so that little evaporation occurs there, and relatively few glands are required to maintain the required moisture. Cut a large opening into the sinus, however, throwing the sinus into the channel of nasal respiration, and drying occurs with injury or destruction of the cilia. Infectious material continues to be thrown from the remaining walls and the means of expelling it has been removed.

Contrary to a long-accepted view that nasal infection speedily incapacitates the epithelium and its cilia, these structures are found working vigorously in the presence of pus, even in advanced cases.

The wide-open or half-obliterated cavity receives the impact of inspired air, dries, and is unable to cope with its viscous or crusted

secretions. The moderately opened one, on the contrary, retains its moisture and encourages its cilia to keep it clean. The various flaps, which are sometimes retained at great pains, do little to remedy this situation in the presence of wide openings and at the same time retain much of the infection which lies in their mucosa and might better be eradicated. At least at the present writing, I believe that obliterating operations which throw a sinus into the general nasal cavity are to be avoided.

Where an actual obliteration can be accomplished *with the destruction of all walls*, as in the frontal sinus, the operation is more likely to be successful. Extensive radical sinus surgery should be regarded as similar to an amputation. There is certainly justification at times in removing a leg, and the operation may be executed with finesse, but the result is a one-legged individual from that time on.

DISCUSSION

DR. AUSTIN A. HAYDEN: I would like to ask Dr. Proetz if he would not take some exception to his pronouncement not to use suction. I presume he means not to use mass suction. It would seem from some of the pictures he has shown that suction is possible, and possibly of decided advantage if it is not used in a closed cavity, and if used in such a way as not to injure the mucous membrane—in other words, not massive suction.

I was wondering as he spoke about the care of the mucous membrane in operating, and I noticed he mentioned at least twice the Caldwell-Luc operation. I presume that a counter opening under the turbinate with the Caldwell-Luc contraindicated. That is, that a second ostium would not be in accordance with his ideas, at least not a large opening that would not promptly close.

I have enjoyed seeing these pictures and know very well the difficult photography that was required and the skill that was necessary to get these results. The secretary and the Society are to be congratulated on having one of our own members, even though he lives in Chicago's largest suburb, come here and present this work.

DR. SAMUEL SALINGER: I happen to have had the good fortune to be present in St. Louis at a meeting of the Triological Society, about six years ago, I think, when Dr. Proetz presented his first paper on the subject of displacement. At that time he proposed it as a diagnostic procedure. Little did we then think that the subject was to lead to contributions of far greater importance and interest. I have had occasion to read almost every paper written on sinus disease in almost every language during the past four years, and have been

astonished to note the interest that has been aroused by the work which Dr. Proetz started, and to observe the effect it is having on the therapy of sinusitis all over the world. There is a definite tendency to treat the sinus with greater respect with less surgery, with the use of milder drugs than formerly.

I was very pleased to hear Dr. Proetz's remark regarding massive suction, for it has been my habit during the past five or six years to avoid this treatment for the reasons he outlined. If you are going to use suction it seems much better to use a small cannula directly applied into the meatuses to withdraw secretions which will free the ostia in an agreeable manner. Such a method is far more comfortable for the patient and certainly more effective than suction applied at the distant anterior nares.

Dr. Arthur W. Proetz (closing): I am glad to be allowed to go into this question of suction a little. By massive suction, of course, I mean taking an olive tip and putting it into the nostril, holding the other nostril shut, and then exerting strong negative pressure, which is a common practice if you can rely on what patients say. I am certainly in favor of using a cannula under direct vision for removing the secretions. If one puts a little ephedrine into the sinus to render the secretion a little less sticky and lets the cilia remove it, they will do it much better.

As to Dr. Hayden's question about the Caldwell-Luc operation and the counter opening, I make a counter opening. The Caldwell-Luc procedure is quite different from the other things I am talking about. This counter opening has not the disadvantage of throwing the air stream into the sinus.

Contribution to the Treatment of Vasomotor Rhinitis

Alfred Lewy.

(Author's Abstract)

Caustic applications, surgery and ionization cause symptomatic relief apparently in direct proportion to the severity of the insult to the tissues. For about two years Dr. Lewy and his associates have been using resorcinol as a cautery agent, with a better percentage of success than with the other treatments mentioned. It is applied as a watery paste over the entire nasal mucosa, including the middle meatus, after a preliminary application of 3 per cent cocain. The reaction usually is not severe. Sensitive patients may be given 1½ grains pentobarbital. The relief may last from a few weeks to several months and in a number of cases treated about two years ago

there has as yet been no recurrence. It has not been successful in the ragweed hay fever. Other remedial measures may be used at the same time, e.g., hypodermic use of free iodine as suggested by Glasscheib. Bipolar diathermy of the inferior turbinates may be combined with it.

DISCUSSION

DR. IRVING I. MUSKAT: I have used this method in hyperesthetic rhinitis and had a similar result, after Dr. Lewy told me about it. I think in my hands it has been about the best thing I have used, after using the other methods in vogue. I have encountered some reaction in some patients, whether neurotic or not I cannot tell, but we know that the hyperesthetic individual has some neurotic basis. The method is very good and gives relief, sometimes lasting for many months, as Dr. Lewy stated.

DR. ALFRED LEWY (closing): I am sorry I cannot tell you what the histologic effect is on the mucous membrane. I would like to know about that and will try to find out.

Cook County Hospital Staff Conference

DR. T. C. GALLOWAY: This presentation is an attempt to show how we conduct our staff conferences at Cook County Hospital. It is difficult to preserve before such a large group the spirit that has made it seem successful to us. We shall pretend that we are sitting by ourselves and shall try to be as informal and spontaneous as we are at home. We ask that you remember that our victories do not come to autopsy, that criticism of diagnosis and treatment is easy in retrospect and we ask that he who is without clinical sin shall throw the first brickbat.

Our usual program is to take up: (1) deaths, (2) errors in diagnosis, (3) unusual cases, (4) statistical studies from our ward, (5) report of special investigations.

Temporal Lobe Abscess

(History presented by Dr. Robert Lewy; pathological findings by Dr. Ben W. Lichtenstein.)

A. O., a woman, aged 36, was admitted to a medical ward in the Cook County Hospital on December 3, 1936. The history obtained was that she had an infection of the ear six months previously, associated with frontal headache which persisted until two months ago. At that time she entered another hospital and a simple mastoid operation was done. The operation failed to relieve her headaches.

She was brought to the Cook County Hospital in coma, the exact duration of which could not be ascertained.

On admission her temperature was 100° F., pulse 96, respirations 22, blood pressure 124/70. The left pupil was fixed and dilated, there was a ptosis of the left lid and a suggestion of a left facial paralysis. The optic discs showed some haziness of the lower margins.

A spinal puncture was done which showed the fluid under increased pressure. The Pandy test was ++, sixty cells per cmm., type not determined.

A tentative diagnosis of brain abscess of otogenic origin was made and was strengthened by pulse rate of 52 on one occasion. The patient was transferred to Ward 21, for it was obvious that immediate surgery was indicated.

Examination in the ear, nose and throat department showed a bilateral Kernig's sign and a purulent, nonodorous discharge from the left ear. An old mastoid scar was noted. The left tympanic membrane was discharging in several different places.

The patient was examined by an attending man, who felt that she had a left temporosphenoidal abscess.

On operation a recent antrotomy wound with considerable softening of the bony structures leading to the mastoid tip was found. There was organized exudate over the dura of the middle fossa. The dura was greatly thickened. A large temporosphenoidal abscess was found with a needle. The lateral sinus and the posterior fossa dura were essentially normal. The patient lingered until 10:50 p. m. The temperature rose to 106° F., the pulse became imperceptible and she expired six hours after operation.

DR. BEN W. LICHTENSTEIN: Autopsy revealed a well nourished, 36-year-old Indian woman. On removing the calvarium and incising the dura a swollen and edematous brain was seen. The leptomeninges were injected but there was no apparent leptomeningitis. The defects in the skull and dura mater as previously described by Dr. Robert Lewy were found. On sectioning the brain a 5 x 4 x 3 cm. in diameter abscess was found in the left middle and inferior temporal convolutions. This abscess extended from the subcortical white substance into the gray substance reaching in one place the pia mater and it was filled with a light yellow purulent material. Microscopically the brain abscess had a poorly developed capsule. The inner layer consisted of masses of polymorphonuclear leucocytes and cellular debris. The middle layer was rich in fat-laden mononuclear cells

and newly formed blood capillaries, while the outer layer contained large numbers of fibrocytes, plasma cells and gitter cells. The adventitial spaces of the cerebral blood vessels in the vicinity of the abscess were crowded with lymphocytes, the picture of the so-called nonsuppurative encephalitis. The leptomeninges at the base of the brain were infiltrated with large numbers of lymphocytes, the so-called aseptic meningitis.

The anatomic diagnosis was: large temporal lobe abscess on the left side of the brain with nonsuppurative encephalitis in the vicinity and aseptic meningitis at the base.

DR. T. C. GALLOWAY: Could you tell us the age of the abscess?

DR. LICHTENSTEIN: The development of brain abscess is a very controversial subject, especially its development from a suppurative focus in the middle ear. It is the consensus that there first develops a localized pachymeningitis, this spreads inwards provoking a localized sealed-off leptomeningitis and thereby organisms may enter the brain. There are many other conceptions. It may be retrograde through the veins. It is not lymphatic, for the drainage of the brain fluids is outward into the subarachnoid space. It is difficult to tell the age of an abscess if the capsule is poorly developed. When the wall is composed of dense fibrous tissue we can definitely state that that abscess is an old one, but as a brain abscess usually grows by the development of foci of suppurative encephalitis in its vicinity, followed by disintegration of the primary capsule the abscess may be of long duration and its wall poorly developed. It may be present for months but at autopsy much of the abscess wall that had been laid down may have been destroyed by the spreading suppurative encephalitis.

DR. SAMUEL J. PEARLMAN: It is difficult to make a diagnosis upon entrance to the hospital of a patient in a state of coma when no relative or friend is present to give the history. When, however, there is a history of suppuration in the temporal bone, a further history of a mastoid operation some time previously, where there has been severe headache ever since the operation and then a descent into coma, there is present a sequence of events which makes the diagnosis of intracranial suppuration by extension from the middle ear and mastoid tracts rather plain.

It seems always to be a matter for much debate as to what course to pursue in such a case. Certainly such a patient, profoundly ill, cannot expect much from surgery, and yet there are cases on record in which a comatose patient had a brain abscess evacuated and

made either a temporary or complete recovery. Even when surgery seems clearly indicated, localization of the abscess is usually not easy. One may feel that it is located in the temporosphenoidal lobe only to find at postmortem that it was in the cerebellum. The classic signs of either location are many times absent in practice. If the surgeon feels sometimes that a brain abscess is present and does not find it in the most likely location, he should then search in the other locality. Here, we felt that we would search the temporal lobe first, but were convinced that if we did not find it that we would then search the cerebellum. As you have just heard, the abscess was found in the temporal lobe, but to no effect. We were distressed that the patient went for two months with headache, and perhaps without the benefit of medical advice. An earlier exploration might have done her some good.

Now as to methods of treatment: I must confess that I have, most of the time, no positive guide and authorities do differ greatly on the treatment of brain abscess. My own feeling has been that we, in most cases, are compelled to operate about the time that a diagnosis is made. The uncomplicated abscess, in good general condition, should wait as long as possible. Certainly, the figures show that those operated upon after the third or fourth week from the onset of symptoms, show a higher percentage of recoveries than those where intervention is necessary earlier. However, in most cases, the patient comes to us not with an uncomplicated brain abscess, but with one present along with other things such as generalized leptomeningitis, rupture into the ventricle, lateral sinus thrombosis, sepsis, etc. The addition of any one of these complications makes the prognosis for recovery much worse.

As to the formation of a capsule—here, again, there is much difference of opinion. Walling off seems to be a situation in which time is not the only factor. Some brains seem apparently to show little capacity for walling off. The nature of the offending organism may be important, in addition. There are some who feel that they can tell what is going on by spinal puncture. If the number of cells is not high, if most of them are lymphocytes rather than polymorphonuclear cells, if bacteria are absent, then one has reason to believe that the brain is putting up a good fight, or that the invading organism is not as virulent as it might be.

In other instances, it is apparent that if an operation is not undertaken at once the patient will have no chance at all. The better the patient looks and feels, in general, the better is the prognosis. Advancing cerebritis, without walling off, can be clinically guessed

at if the patient looks toxic, has a low grade temperature and has a high cell count in the spinal fluid with many polymorphonuclear lymphocytes. While walling off is what the surgeon desires, a brain abscess too well walled off offers resistance against cure, for abscess heals by collapse. A thick capsule prevents collapse and hence delays or prevents complete healing. Such brain abscesses are best handled by complete enucleation, a formidable procedure in itself. No doubt too many patients succumb because of the eagerness of the surgeon to drain well. It is these repeated attempts at drainage, producing new traumatism, that ultimately produce death.

I should like to see reports on the cure of brain abscess similar to the reports which are made today on the cure of carcinoma; that is, after five years and not after six months to one year. The figures, I am certain, would be different than those ordinarily seen in the literature. Many patients, apparently cured at the end of six months to a year, would return for another tapping, and so until finally in one recurrence they would die. Others would develop epilepsy which would make them hopeless invalids, useless to themselves and to society.

To sum up, with few exceptions, the treatment of brain abscess today is not a surgical nor medical triumph. I cannot help but feel that we are very far from a satisfactory understanding of the handling of this disease.

DR. ALFRED LEWY: What was the immediate cause of death in this temporal lobe abscess, and in what way did it cause the death of the patient?

DR. GALLOWAY: Perhaps Dr. Lichtenstein can tell us about that.

DR. LICHTENSTEIN: The question as to the immediate cause of death of the patient is very frequently asked of the pathologist by the clinician. In the majority of cases the patient dies from a summation of factors, no one thing in itself being of vital importance. In our case the edema of the brain, the toxic degeneration of its ganglion cells, the inflammation of the meninges and the operation of shock, all together played a röle in provoking the patient's death.

DR. GALLOWAY: Does Dr. Muskat wish to add anything?

DR. IRVING I. MUSKAT: I have nothing to add, as Dr. Pearlman reviewed the subject very beautifully, except that we might talk about the mode of operation in these cases. We know that anesthetics have a deleterious effect on brain tissue, and any over supply of

anesthetic increases the encephalitis, and it stands to reason that the least amount of encephalitis that is produced will be of the greatest benefit. Ether is the least injurious to the brain tissue as far as anesthetic procedure is concerned. Nitrous oxide is very bad for it increases cerebral hyperemia and edema and, naturally, therefore produces more encephalitis. When a patient is comatose and you can use a local anesthetic or no anesthetic the patient is better off. No antiseptics should be used in the brain cavity, for everything we are accustomed to use produces more encephalitis. That does not hold true of the dura, for it will stand chemical trauma. Interference with tissues and the amount of trauma produced through the mallet and gouge should be considered. In irrigating an abscess cavity of the brain physiologic saline is the only chemical that the brain tissue can tolerate with impunity.

DR. GALLOWAY: Dr. Pearlman and I have some debate about the time of operation in brain abscess. It is my opinion that almost any abscess that has to be operated upon in the first two weeks will not recover. There has never been a series that equals Macewen's, and all of his cases were operated later, and I have a feeling that if one can date the onset of the brain abscess by the chilliness or other symptoms, one should wait for four weeks until there is some walling off. It is hard to date the beginning of this abscess, and it is true in any case this patient would have died.

I would like to ask Dr. Pearlman if he thinks a ventricular puncture would have tided this patient over, or if he thinks we should have turned the patient over to a neurosurgeon?

DR. PEARLMAN: Speaking of Macewen's figures, it is true that in the past forty years no one has equalled his successes. He had much experience and shrewd common sense, and some apparent disadvantages which really worked in his favor. Spinal fluid findings were not stressed so much, and hence not used in his day to indicate operations. Macewen's cases were the chronic cases. All the others, including those that had complications, were dead. Those who lived long enough to get into his hands were the most favorable, and with his simple application of "masterly inactivity," a majority did exceedingly well.

One point in favor of operation on the mastoid process would be that we would not overlook extra- or subdural collections of pus. From time to time the patient presents the signs of brain abscess when he has none. Cleaning out of the suppuration focus in the temporal bone cures many of these. The finding of serous accumulations and

their drainage cures other types of brain abscess, but there is no simple rule to follow which tells exactly how long to wait.

At one of our conferences, Dr. Lichtenstein stated that one should wait as long as possible. That if the time element from the possible beginning of brain abscess is short, it would be better not to search for it, but to do a wide decompression, thus relieving the compressive phenomena.

Some individuals believe in doing ventricular puncture and so reducing intracranial pressure. Temporal lobe abscesses have a tendency to spread toward the ventricle and such a procedure might hasten a rupture into it. As to whether we should turn our cases of brain abscess over to a neurosurgeon, I am quite willing to agree that their method of approach offers some advantages, but I am not convinced that, generally speaking, their results are better than ours. We, at least, clean out the original source of infection; find a pathway often, but are trained to tap the abscess through an infected field. The neurosurgeon has the advantage of attacking through a clean field and requires the otologist to work independently on the suppurative focus in the temporal bone.

Dr. J. Lifschutz: Dr. Curry had a case recently of temporal lobe abscess in which the abscess was diagnosed and drained, but during the operation, although the heart was beating normally, the patient stopped breathing and despite artificial respiration for three hours, he expired. I had a similar experience where the patient was kept alive for eighteen hours in a Drinker respirator and finally died. Unquestionably, it is due to an involvement of the respiratory center in the medulla. Is there any procedure that can be suggested that would enable the patient under such circumstances to resume normal respiration?

Laryngitis (Streptococcus)

Dr. Robert Lewy

J. S., a boy, aged 3, was admitted to the Contagious Ward of the Cook County Hospital on January 2, 1937, with a high fever and a brilliant rash of two days' duration.

On admission the temperature was 104° F., pulse 145. The left ear drum was red and bulging. The tonsils were large, extending to the midline, and covered by a necrotic black slough. There was a small necrotic area in the center of the hard palate. Inspection of the skin showed a diffuse erythematous punctate rash with circumscribed pallor. There was marked cervical adenopathy.

A diagnosis of scarlatina was made, with diphtheria to be ruled out.

The patient was given 30 c.c. of convalescent serum, following which the temperature dropped from 104° to 99.8° F. It was felt that the child had a secondary Vincent's infection. He continued to run a stormy course. On January 5, 1937, 30 c.c. more of serum were given; 285 c.c. of citrated blood and 3,000 units of diphtheria antitoxin also were administered.

On January 8th it was felt that he was improving. The leucocyte count was 26,000, the differential count was normal. On January 10th he developed stridor and was seen by an otolaryngologist. This was the eleventh day of the scarlet and sixth day of a possible diphtheria. Examination showed supraclavicular retraction and an extensive membrane over both tonsils and the posterior pharynx. An exudate of both arytenoids was noted, the cords were not seen. There was some edema of the epiglottis.

The child was carefully watched. The stridor increased during the night. A tracheotomy was considered but an intubation (experimental) was done first. This relieved the stridor. He was given another transfusion of 285 c.c. of blood, and on January 19th he received 250 c.c. of blood. The temperature was dropping. He was extubated and reintubated several times, the last on January 23, 1937.

Other complications included a bilateral otitis media which persisted in the left ear for eight weeks and in the right ear for six weeks. The child ran a septic course for two weeks, with the temperature up to 102° F. daily, and a mastoidectomy was done on the left ear with relief of symptoms.

DISCUSSION

DR. T. C. GALLOWAY: Dr. Curry, will you tell us about this case?

DR. L. T. CURRY: This case presented several problems, but there were two I consider important. First, when should the asphyxiation be relieved? Stridor with retraction of the supraclavicular spaces are my indications for the necessity of promptly relieving the asphyxiation. This child was skinny with marked stridor and marked supraclavicular retraction. It is the degree of these two symptoms, especially in a fat child, which makes difficult the decision of when to interfere.

The other problem was whether to do an intubation or a tracheotomy. I think most of us feel that tracheotomy is indicated, but that is because we do not have a Dr. Hoyne around to do the intubation. Intubation worked very well in this child, but when Dr. Hoyne is not around it is a problem to have an assistant who is capable of replacing the intubation tube. I think it is necessary always to have an expert in this line on the job. An unsuccessful intubation makes for a graver prognosis because prolonged dyspnea leads to a fatal outcome if not relieved promptly.

DR. GALLOWAY: One of the best things about our staff meetings is that through them we get in contact with the other departments. We are very glad to have Dr. Hoyne from the Contagious Disease Hospital come to our staff meeting and talk about this particular case.

DR. ARCHIBALD HOYNE: The honor conferred upon me by being permitted to talk here is greatly appreciated, but I feel considerable timidity in undertaking to refer either to tracheotomy or intubation before a gathering of this kind.

The history of the case just given you is excellent. I think ordinarily such a patient requires tracheotomy. When O'Dwyer devised his instruments for intubation he believed that his operation might be used for practically any condition where tracheotomy is indicated. Few will claim that at present. Tracheotomy may be resorted to for any condition where intubation would be adequate, but intubation may not afford relief in many conditions where tracheotomy is successful. For a while this particular patient afforded a good topic for debate on this subject of tracheotomy and intubation, and it was one of those cases where properly, perhaps, tracheotomy should have been done. For a long time—and I have not changed my feeling very much—it has seemed to me that in diphtheria a patient who cannot be saved by intubation will not be saved by tracheotomy, yet that is not inevitably true. Occasionally a diphtheria patient may have so much membrane above the glottis, as sometimes happens in the "bull-neck type," that it is necessary to do a tracheotomy. However, in the tracheobronchial case, if intubation will not save the patient rarely will tracheotomy for there is obstruction below the bifurcation. Nevertheless, in such cases, we always do an intubation first and if that fails, as it usually does, then we do a tracheotomy—but that nearly always fails, too. In streptococcic infections with marked edema of the throat, as may occur in scarlet fever, measles, and a variety of other infectious diseases, usually tracheotomy must be given preference rather than intubation. Never-

theless, if the patient comes to the Contagious Hospital, usually we do an intubation first. There is no objection to inserting a tube even though it does not accomplish its intended purpose.

In this particular case I was much surprised to find the child was better after intubation. The edema did not well up over the top of the tube, although the tube did sink deeply into the larynx. The next day the tissues were swollen to such an extent that it was necessary to remove the tube and put in a larger one, and I thought we might not avoid a tracheotomy. Possibly the results would have been better if there had been a tracheotomy. We prefer that members of the nose and throat department do our tracheotomies and their cooperation is appreciated.

Recently Chamberlain published an article on tracheotomy and recommended using the Mosher tube. We have been relying on that tube when performing tracheotomies at our Contagious Hospital for about fifteen years. I think I was responsible for buying the tubes and suggesting their value when doing a tracheotomy in our Contagious Hospital. With the tube in place, time is not such an important factor in the operation.

In diphtheria, it seems to me, intubation should be done in preference to tracheotomy if the patient is in a hospital where there is always someone present who can intubate. If the child is at home, or in a noncontagious disease hospital where there is no one with intubation experience, tracheotomy is far safer for the patient. Particularly is this true if the operator is well qualified. Rarely we hear of cases where, with too much enthusiasm, "the surgeon" not only penetrates the trachea but also the esophagus, and I imagine that is not good for the patient. Of course, in connection with intubation, we have errors that are just as strange. When a novice inserts a tube in the esophagus instead of in the larynx and the patient dies he is likely to regard it as a very peculiar case. A patient was brought in one time with a piece of thread hanging out of the mouth. The child had been rushed to the hospital for intubation. Seeing the string I asked if a tube had been put in the child's throat. The mother said, "Oh, yes, he has two tubes." He had two but still needed a third one—the other two were in the stomach.

This subject of intubation and tracheotomy is a matter that the staff members of the nose and throat department and of the contagious disease department of the Cook County Hospital are fairly agreed upon. We are all of the same opinion. That is, to try to do what is best for the patient irrespective of our personal preferences in the choice of operative procedures.

DR. GALLOWAY: I think we should mention the possibility of a direct intubation, which gives a chance to remove membrane. We should recognize that Dr. Hoyne is without a peer as an intubationist, and if we had diphtheria and the question came up I am sure we would want Dr. Hoyne to intubate us. I think we of the nose and throat department feel very strongly that with tracheobronchitis it is necessary to have a tracheotomy for the proper removal of secretion and crusts.

Tuberculosis of the Trachea With Syphilitic Endocarditis

DR. ROBERT LEWY

DR. BEN W. LICHTENSTEIN

A. H., a white woman, aged 33, was first admitted to Cook County Hospital in March, 1936, with a tentative diagnosis of toxic nodular goiter. It was learned that the patient had noted an enlargement of the thyroid for eight years and had lost about forty-five pounds. During the past year she had been very nervous and had a marked weakness of the left arm. The basal metabolic rate was +12, +9 and +2 on three occasions. Careful investigation excluded the possibility that the patient had a toxic goiter.

Physical examination showed an absence of the radial and brachial pulsations in the left arm. The blood pressure on the right arm was 120 70; it was not obtainable on the left arm. It was thought that the patient might have a cervical rib that was compressing the subclavian artery, but roentgenographic investigation gave negative results.

Laryngeal examination April 4, 1936, showed that both vocal cords moved normally. No tumor was seen.

Operation was performed during the following week. Obliteration of the second portion of the subclavian artery was found. The artery seemed to be surrounded by dense connective tissue. The artery was cleared and a segment was excised. The patient made an uneventful recovery and left the hospital after a period of four weeks, her condition not much improved.

Four months later she was readmitted to the hospital because of marked dypsnea, which was particularly noted on lying down and after exertion. At this time it was learned that the patient's husband was being treated for tuberculosis. Physical examination showed that the patient was having labored respirations with a wheezing noise and she was quite cyanotic and dyspneic. The heart and lungs were essentially negative. The leucocyte count was 2,150.

At this time a diagnosis of tracheal obstruction was made and the patient was sent to the otolaryngological department for bronchoscopy. A mass about the size of a marble was seen bulging into the lumen of the trachea. This was above the carina, near the bifurcation, about 30 cm. from the incisor teeth, and obstructed about three-fourths of the lumen.

A specimen was taken of the mass, which was thought to be an inflamed gland. The pathologic report was fibrocaseous tuberculosis.

Bronchoscopy was again done on September 12, 1936, and removal of the mass by desiccation and diathermy was suggested. A low tracheotomy also was advised. Roentgenotherapy was given with definite temporary improvement. A roentgenogram of the chest at this time showed no mediastinal mass, no evidence of tuberculosis or cervical ribs.

The patient's legs became edematous, she developed a low grade fever, coughed a great deal and had much difficulty in breathing. She expired three months after her second admission to the hospital.

A postmortem blood examination showed the Wassermann test to be ++++ and the Kahn test +.

DR. LICHTENSTEIN: Autopsy was performed on this 34-year-old white woman by Dr. R. H. Jaffe. Upon removing the manubrium of the sternum the anterior mediastinum was seen to be bound down by fibrous adhesions. The arch of the aorta was the site of a very marked wrinkling and puckering of the intima, characteristic of syphilitic aortitis. These syphilitic changes had completely occluded the ostium of the left subclavian artery. The essential pathology was found in the trachea. On opening it posteriorly an ulcer 5 x 3 cm. in diameter was found just above its bifurcation on the right lateral wall. This ulcer extended for a short distance into the right main bronchus; its floor was necrotic and several rings of the trachea were exposed. Adherent to the trachea at this point were several enlarged lymph glands which on section were composed of dry, yellow, caseous material. Microscopic examination showed the glands to be tuberculous. In the lung a small subpleural nodule was found in the right lower lobe which was interpreted as the residue of the primary infection. A chain of enlarged caseous tuberculous lymph nodes extended up along the right main bronchus to the region of the bifurcation of the trachea.

The anatomic diagnosis was: (1) Caseous tuberculous lymphadenitis of the peribronchial and peritracheal lymph nodes with per-

foration of one of the lymph nodes into the trachea with the production of a tuberculous ulcer. (2) Marked syphilitic aortitis in the arch with complete occlusion of the ostium of the left subclavian artery.

Pathologically we differentiate several types of tuberculosis of the trachea. First, there is the type associated with massive pulmonary tuberculosis and tuberculosis of the larynx. Second, the type that results from the development of a tubercle in the mucosa from lymphatic spread of the tuberculosis in the lungs. Third, tuberculosis of the trachea as part of a miliary spread. Fourth, caseous tuberculous peritracheal lymphadenitis with erosion through the wall of the trachea, and the production of a tuberculous ulcer and finally, primary tuberculous infection in the trachea.

Our case represents that form of tracheal tuberculosis which is a complication of an endoglandular exacerbation of tuberculous lymph nodes.

Dr. Alfred Lewy: This rare case presents two interesting features. First, that clinically and roentgenologically no pulmonary tuberculosis was demonstrable during the life of the patient. The diagnosis was made when the tracheal lesion caused enough dyspnea to have the patient transferred to the otolaryngological department, when bronchoscopy was done, a biopsy made, and the lesion was diagnosed. It is evident that a very careful autopsy is necessary to exclude the possibility of an old tuberculous lesion which may have caused a supposed primary laryngeal tuberculosis, as is shown by this case of tracheal tuberculosis.

The other interesting thing is that at Cook County Hospital, where Wassermann and Kahn tests are routine, during the life of this patient, so far as the record shows, no such tests were made and the syphilis also went undiagnosed until she came to the autopsy table where the postmortem Wassermann test revealed it.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Meeting of Monday, April 5, 1937

THE PRESIDENT, DR. IRA FRANK, IN THE CHAIR

Program presented by University of Illinois College of Medicine.

Swellings of the Neck

R. B. MALCOLM

(Author's Abstract)

The following cases were reported:

Tumors and cysts	250	Location of tumors and cysts:	
Tuberculous adenitis	100	Submaxillary triangle	72
		Carotid triangle	163
Total	350	Muscular triangle	15
Origin: Epiblastic		Mesoblastic:	
Cysts	46	Cysts	2
Tumors	127	Tumors	25
Benign	28	Benign	12
Malignant	99	Malignant	13
		Hodgkin's	40
		Leukemia	10

Submaxillary triangle: Parotid, benign 23; mixed tumors, 22; papillary cyst, adenoma 1; malignant, 15; adenocarcinoma, 12; squamous, 2 papillary; cystadenocarcinoma, 1.

The results in benign tumors were excellent, although there were some recurrences requiring second operations. The results in malignant cases were very disappointing. Four adenocarcinomas developed in previously existing mixed tumors.

Submaxillary salivary gland: Cysts 3, mixed tumors 4, adenocarcinoma 1.

Sublingual salivary gland: Cysts 2.

Resections of submaxillary triangles for carcinoma of lip, 30; metastatic carcinoma, 6. Resections of submaxillary triangles for malignant melanoma, 2.

Thyroglossal duct cyst, 20. Result, 19 excellent; 1 required second operation. Cystic hygroma, 1.

Carotid triangle: branchial cysts, 19. The results in all these cases were excellent. Every case arose from the second cleft. All were deep to posterior belly of digastric, superficial to stylopharyngeus and lay between the external and internal carotid arteries.

Branchiogenic carcinoma, 4. Three were resected, taking away the jugular vein. Two patients died within a week; the third lived eighteen months. The fourth involved the vein and carotids in a woman aged 70, so no attempt was made to remove the tumor.

Tumor of carotid body, 2. The first was a malignant tumor and attempt at removal was unsuccessful. The patient died some months later. Diagnosis: Ganglioneuroblastoma. The second patient was a woman aged 37, with a small mass in the region of the bifurcation which was thought to be a lymph node, but on exposure the color made the diagnosis. It was successfully removed, taking with the tumor the adjacent sheath of both carotids. Blood pressure at commencement of the operation was 120 80, and on traction on the tumor it fell to 70/50. When the tumor and nerve to it were removed the pressure went up to 100 75. The pressure following operation went up to 180 80 and persisted for several months, gradually coming down to normal. Microscopic examination showed an adenoma of the carotid body, measuring 6 x 4 x 3 cm.

Metastatic carcinoma, 73. These tumors were secondary to carcinomata in the tonsil, pharynx, tongue, lip, larynx, esophagus, thyroid, stomach and even the lung, adrenal and other areas which could not be differentiated. Of particular interest were four metastatic hypernephromata and four neurocytomata.

Tumors of lymphatic origin: Lymphosarcoma, 5 of the lymphocytic type; 3 of the reticulum cell type. This group was of particular interest on account of the variation in size and the softness to the touch. Clinically this condition resembles Hodgkin's disease.

Other tumors of mesoblastic origin: Fibrosarcoma, 2; lipoma, 9. These were all subfascial and were of the dissecting type, so that when they were completely removed practically the whole neck had been exposed.

Lymphangioma: This was in a child aged 10. On removal it was found to arise from the radicles of the right lymphatic duct. Neuroma, 1; neurofibromatosis, 1.

Hodgkin's disease, 40.

This series gave the greatest variation in the histologic findings. In some cases it was difficult to differentiate them from lymphosarcoma.

Leukemia, 10. Biopsies only were done with one exception, in which case the writer did a total thyroidectomy as an experiment to reduce the basal metabolic rate, thus hoping to improve the condition. The patient died in six weeks.

Muscular triangle, 15. All these cases were carcinoma of the thyroid. The results following thyroidectomy, and, in some cases, removal of the adjacent involved lymph nodes, were most disappointing. One interesting case occurred in a girl aged 11 years.

All of these cases were from the records of the Research and Educational Hospital of the University of Illinois College of Medicine and the private practice of the writer.

Roentgen-Ray Studies of the Soft Tissues of the Neck

PAUL H. HOLINGER (by invitation)

(Author's Abstract)

The soft tissues of the neck lend themselves readily to roentgenologic study. This is due to the variation in density of the gross anatomic structures. The trachea, entirely hollow and air containing, serves as a perfect background against which the soft structures and laryngeal cartilages may be silhouetted.

Such studies, both anatomic and pathologic, have been carried on since shortly after Roentgen's discovery; of note are the works of Sheier, Thost, Iglauer, Hay, Mosher and the Jacksons.

The value of roentgen studies of the soft tissues of the neck is dependent upon cooperation between the roentgenologist and the laryngologist. The final evaluation of the pathology must be made by comparison of the direct examination and the roentgenograms, one study supporting the other.

In infants and children, as well as in adults in whom indirect examination of the hypopharynx and larynx is impossible, the roentgenogram is indispensable in making a preoperative diagnosis. This makes a blind approach unnecessary.

Special roentgen studies must be made of the soft tissues of the neck in cases of dyspnea, hoarseness and dysphagia. These studies are indispensable in cases of foreign body, pharyngeal, laryngeal or tracheal tumors, and esophageal obstruction. They are of special value in the fitting of tracheotomy tubes. The extent and clinical course of a lesion, benign or malignant, may frequently be determined more accurately on the roentgenogram than by direct examination. In no instance, however, can the film be substituted for direct examination and biopsy.

DISCUSSION

DR. FRANCIS L. LEDERER: You will grant that the time allowed is not adequate for speakers of such wide experience to present all of this material and do justice to it; nevertheless, they have covered a great deal of ground.

Dr. Malcolm's experience with 350 cases certainly accounts for his enthusiasm, especially due to his profound respect for and knowledge of anatomy and pathology. So far as we, as laryngologists, are concerned, the difficulty arises in confusing swellings of the neck, particularly in the early stages with lymphadenitis of pharyngeal origin. When this particular type of lymphadenitis fails to respond to therapy we being to think of abscess, and when leucocytosis is absent, together with fever, fluctuation or tenderness, we often suspect a tuberculous adenitis, involving the cervical glands, especially if the process is bilateral.

The branchial cysts are very interesting. If confronted with a history that the mass had been present for a long time and had failed to increase in size we might be suspicious of it.

The lymphoblastomas which Dr. Malcolm presented with their histopathologic findings are very interesting. Hodgkin's disease, with the particularly beautiful slide, was definitely mentioned. I think we are aiding materially by just roentgen-ray in those cases, possibly with the therapeutic test if they respond to roentgenotherapy.

Bronchiogenic carcinomas or tumors of bronchial remnants occasionally confront us. The branchiomas increase rapidly in size. They are usually located in the upper anterior cervical triangle. These patients consult us with hoarseness, otalgia and pressure symptoms. The metastatic tumors of thyroid, laryngeal, pharyngeal and sinus origin occasionally present themselves, as well as those due to leukemia.

The mixed tumor Dr. Malcolm showed on the lantern slides had three different types of tumor pathology represented, with malignant degeneration in one section. This very interesting case history dated back to 1912, the patient having had eleven resections before I referred her to Dr. Malcolm. I am indeed sorry that Dr. Malcolm did not have more time to fully cover all the details of such interesting cases.

Dr. Holinger's paper illustrates the value of the roentgenogram of the neck as a very definite corroborative, diagnostic and prognostic aid. He has presented an excellent selection of material which

emphasizes the importance of the close study of the films which add much to our information of the structures in this region. The short time allowed the essayist did not permit covering every type of tumor or pathology that might be visualized in this region. The neoplasm and destruction due to tuberculosis and syphilis and the like can also be visualized in the roentgenogram. Dr. Malcolm and Dr. Holinger gave us something very well worth while.

Dr. Walter H. Theobald: I had a somewhat selfish motive in asking Dr. Malcolm to discuss swellings of the neck for us, for I have been confronted with such cases which were troublesome in diagnosis and thought some of the rest of you might be having the same difficulty.

A patient seen recently who had a swelling of the neck was referred to me from Berlin and I was impressed with the fact that no laryngeal examination had been made when she was in the United States two years ago. At that time her tonsils were removed because of the cervical swelling. Subsequent examination in her native country disclosed the presence of a sarcoma at the base of the tongue. Following vigorous roentgenotherapy the swelling and lesion disappeared.

I wish Dr. Malcolm in closing would tell us something about the treatment of inflammatory swellings of the neck by roentgenotherapy.

Dr. Robert B. Malcolm (closing): I believe that every case of tuberculosis of the neck where there is no fluctuation should be treated with the roentgen-ray. That gives excellent results. If there is fluctuation an incision should be made, the pus evacuated, the wound sewed up tight and then treated with the roentgen-ray. In other inflammatory swellings I think Hilton's method is the method of choice.

I feel that all tuberculosis reacts beautifully to the roentgen-ray. Some of the sarcomata melt away with radium and roentgenotherapy but, unfortunately, they return with increased vigor and you know the terminal result. In the treatment of lymphosarcomata roentgenotherapy is hopeless.

Abscess of the Brain

Eric Oldberg (by invitation)

(Author's Abstract)

Abscesses present a multiplicity of problems, and each abscess is a problem in itself in that its position, the type of organism which infects it, its age, the amount of walling off present, the amount of

edematous brain surrounding it, and the seriousness of the damage which its presence produces, are all factors which influence judgment as to treatment.

This paper outlined the radical and conservative methods of treatment in general use. The author favors conservative treatment for most abscesses, with repeated tapping and eventual extirpation, if necessary. Statistics were given as to favored sites for abscesses, and experiences with the several varieties were detailed.

DISCUSSION

DR. PERCIVAL (by invitation): I used to think I knew something about the treatment of intracranial infection, but the older I get—and I am not so very old yet—I find that every time I do something I wish I had done something else. For me the anxious period is not when there is an abscess fairly well developed, but when the otologist has done a mastoidectomy and the patient starts to have a drop in temperature and begins to feel better, and then develops symptoms again. Then is the anxious period not only for the otologist but for the neurosurgeon. What is going on? Is the patient getting a reinfection of the mastoid, is he getting a sinus infection that is going on into meningitis, or what have you? That is a very anxious period for everyone concerned with the case, and that is the period that is most difficult to treat, for what you are going to do depends upon the diagnosis and a diagnosis has to be made quickly. One has to make up his mind what he is going to do or whether he is going to do anything. If the patient goes on for a week or two and does not die then you have usually plenty of time to make up your mind what you will do and what the patient has.

We will suppose the patient has an abscess and has gone on for a week after his second rise in temperature, and that he obviously has not got meningitis, for you have made spinal punctures and have found only a few cells and you know that he is not shooting a daily high fever and there are no bacteria in the blood stream. He probably has no mastoiditis so there is no reason to go in again, but the patient is very sick, has vomiting, perhaps some headache and some swelling of the optic discs. You then begin to think that there is some infection which has passed through the meninges and into the brain. Then what are you going to do? From some bitter experiences in the past I have come to feel as Dr. Oldberg does, that the less you do the better. If necessary, make a small opening and make an attempt to aspirate the abscess. Do that only if the patient has choking of the optic discs and increased intracranial pressure, so that he cannot go on without something being done. By tarrying one has the risk of

infection passing into the ventricles, so that the patient gets a ventriculitis and a secondary meningitis, but that risk I think is less than from interfering with the abscess at that stage. If one simply takes a needle and punctures the abscess and aspirates repeatedly, as often as is necessary, sometimes the abscess will heal. At any rate it will sterilize itself, build a good thick wall, and you will not have to operate on the abscess, at least immediately. Dandy leads one to believe that healing will always happen, but I think that opinion is exaggerated.

If you puncture several times and the symptoms continue to recur how will you treat that abscess? Under those circumstances, as Dr. Oldberg indicated, you may treat in several ways. You can put in a drain, allowing the abscess to collapse upon itself and allowing the drain to extrude itself, so that it will heal. But in some cases the drain is extruded, the wound closed exteriorly, and an abscess forms beneath and has to be subsequently operated upon. Another method is to open the dura widely and allow the abscess to extrude itself. That will happen, but in many instances a lot of the brain also will extrude itself with it and we do not wish that to happen for we are apt to get hemiplegia and other unpleasant things. A third method of handling these abscesses has recently been used to a great extent in Paris, particularly by Vincent and his associates. That is, puncturing several times until the abscess forms a firm wall and then going in and extirpating the abscess as if it were a tumor. That has happended to surgeons before, but by accident.

Vincent now has a large number of cases in which he has deliberately extirpated abscesses in that way with excellent results. I was so impressed with his work that I have done it myself and have succeeded with it very well. I think this is an advance in brain surgery, but I am not willing to advocate it for every case on the basis of my own experience, one case done by accident and one intentionally. Suppose one attempts to do this with the ventricles, the meninges, and everything wide open and he is unfortunate enough to rupture the abscess. That happened to me the other day. I was very enthusiastic about my first success and was going to extirpate another abscess. So I did—I got around the abscess wall and behind it and was just about to extirpate the abscess when pus began to well out, then I found there was a fresh daughter abscess just behind the other. I thought that was the end of that child. The meninges and the ventricles were wide open and there was pus in the ventricles, in the meninges and all over the brain. The child was given prontolin by mouth, and although the organism was a hemolytic streptococcus the child got well. I took the bone flap off, opened widely, packed gauze

into the cavity from which I had extirpated the abscess and let the fluid drain out and the child got well. You can credit that to prontolin or not, just as you wish.

I feel that one should puncture abscesses repeatedly until they have time to wall themselves off. If one is obliged to continue puncturing them and they continue to reform then you have a choice of two things, either insert a rubber drain or extirpate them as they do in France. I am very much impressed with the latter method and will continue it until my results teach me not to do it.

About the time when infection first gets into the cranial cavity, I have never been able to make up my mind. I have been horrified at what otologists do, but have not been able to make up my mind that I could do any better. I used to be told that one should never go into an infected area, but should make another wound entirely separate and drain through the opening. It has always made me shudder to see otologists open up a mastoid abscess, then put a hemostat through the dura and see spinal fluid come out. I have always been sure that meningitis would occur, but to my surprise it has occurred in very few cases. I think the answer is that the spinal fluid washes the infection outward and the opening is soon closed by edema and adhesions. So when infection is just getting into the cranial cavity I am satisfied to let the otologist do what he wishes and see what will occur. I have not been able to make any suggestions as to what else to do, and have always hoped that the otologist would take care of the cases in that stage. After that period is over, if a patient begins to develop brain abscess, I feel more inclined to take a hand and try to do something for the patient.

Dr. Eric Oldberg (closing): I wish to thank Dr. Bailey for his discussion, and to repeat that my experience has been most favorable with conservative methods of treatment. I have resorted to radical methods only when the former have failed.

Psychoneurotic Symptoms in Otolaryngology

Alfred P. Solomon (by invitation)

(Author's Abstract)

A classification of the clinical manifestations of the psychoneurotic patients was presented, objectifying the problem of their management by the otolaryngologist.

The conversion hysterias, conversion aphonia, deafness, anosmia and loss of taste were exemplified and their symptoms discussed. The

importance of recognizing that the conversion hysterias represent a satisfying psychoneurotic adjustment to an emotional conflict or conflicts was stressed. The psychoneurotic adjustment was distinguished from the secondary gain achieved by the presenting symptom, in securing attention, interest and sympathy. The problem of treatment in relation to the unconscious purposefulness of this phase of the conversion symptom was explained.

Anxiety hysteria, hypochondriacal fixations, schizophrenic hypochondria and manic depressive somatic delusions were presented as a second group because they represent that class of patients who seek treatment for somatic symptoms without organic basis. Common to all is an anxious wish to be treated palliatively or surgically in the presence of a rejection of the recognition of the conscious or unconscious emotional problem involved.

Much emphasis was placed on the fact that these patients prefer organic explanations and that their oft expressed willingness to submit to an operation is not evidence of the organicity of the complaint.

This group was superficially differentiated on their response to reassurance by the attending physician. The nature of the transference relationship was explained.

The patients with anxiety hysteria were shown to be very grateful for reassurance and the more eager of the group to listen to a psychogenic explanation.

The hypochondriacal fixations were exemplified by case reports to bring out the deep seated intensity of the fixation ideology and the attending dangers in doing anything surgically about their symptoms. It was pointed out that they resent reassurance. This was contrasted with the vituperative demands for surgical treatment which characterize this group.

The schizophrenic hypochondriacal patients were shown to be even more refractory to reassurance and to be even greater operative risks. Such treatment often intensifies the condition. In this instance a warning was issued about the paranoid tendencies that sometimes follow operations on these patients.

The manic depressive psychotic patients with somatic delusions, where the latter often are so prominent that the consequent demands for treatment often mask the primary depressions, were exemplified. These patients are grateful for reassurance but are unable to hold

the relief from anxiety thus gained, although they are even more suggestible to hints dropped that pathology may exist when the anxiety is thereby increased. The deep seated feeling of guilt existing in this disease was shown to motivate the symptoms.

A third group of patients who react with a psychoneurosis to the use of artificial aids was described, with attention drawn to the fact that the artificial aid is objected to because of reasons which are related to previous personality problems. If these emotional conflicts are kept in mind when discussing the use of the artificial aid with the patient, the wearing of it is made much easier.

DISCUSSION

Dr. Francis L. Lederer: Lest Dr. Solomon's paper be placed in a facetious spot, I wish to say that it constitutes to my mind one of the most important features that could come before the Society. It can well be said that if we eliminate the commonplace things from practice we will have no practice, but I think it is better to say that if we eliminated the psychoneuroses, we would eliminate most of our practice. Were we to carefully think over the many conditions which Dr. Solomon has so well brought before us, we would recognize many of the patients who have consulted us. We must have a feeling of guilt for having abetted psychoneurotics in many instances. As is common practice, if no organic disease is found, resort is had to swabs, sprays and tampons. I do not know whether Dr. Solomon's treatment is better or more effective than that, but nevertheless I feel many such cases have been made worse by such classic therapy. Since having availed myself of the experience of men in Dr. Solomon's field, I have found many interesting entities such as he has presented tonight. Perhaps he could more adequately have covered the ground had he recited more case reports, and you would recognize your Mr. Joneses and Mrs. Smiths accurately described, for whom you removed tonsils and so on, but their symptoms did not subside and you justified yourself in thinking you did them no harm and perhaps did some good. I have found suggestive therapeutics a very serious menace in this special practice of medicine. I am reminded of the patient who comes in with some small growth on the tongue who thinks it is carcinoma. You think, and know, it is lymphoid tissue, but you remove it to impress the patient. Then you think you have reassured the patient with a negative report on the biopsy. But he comes back and then you apply silver nitrate and finally the patient becomes discouraged, and the same process repeats itself in many other hands. This is only one of the many typical acts in the course of special practice.

I think we can study these problems with interest and profit thereby.

DR. ALFRED P. SOLOMON (closing): I wish to thank Dr. Lederer for what he has said. He has indicated that he has a clear understanding of these problems.

I do not offer a method of treatment, merely a plea that we understand what we are doing and why we do it.

Books Received

Diseases of the Nose and Throat.

By Sir St. Clair Thomson, M.D., F.R.C.P. Lond., F.R.C.S. Eng., LL.D. (Hon.), Winnipeg, Médecin diplomé en Suisse and V. E. Negus, M.S. Lond., F.R.C.S. Eng. Fourth Edition revised. Cloth. 8 vo. of 976 pages with 13 color and 16 radiographic plates and 386 figures. New York: D. Appleton-Century Company, 1937. $14.00.

An important publication of the past summer is this fourth edition by Thomson, brought up to date (since the third edition of ten years ago) with the cöoperation of V. E. Negus.

Someone has called this text the "laryngologists' Bible," and such it will no doubt continue to be. Every subject is treated with the most painstaking completeness of detail, and the illustrations are adequate in every way. Descriptions are dispassionate and unbiased, and all statements are supported by ample and responsible authority.

The references to be found in this book deserve special mention. It would be difficult for the student to find a more complete and practical list than that which comprises the footnotes on every page—so catholic in scope as to constitute a veritable bibliography of rhinolaryngology.

New emphasis is given to peroral endoscopy; new material on diseases of the esophagus has been added; "the 'Killian operation' is no longer described; less dangerous and more effective methods" are suggested, and there is a fairly general revision of the text.

"My own task," writes Sir St. Clair in his preface, "has consisted chiefly in trying to exercise the right judgment which we all pray for in all things, no easy matter in medicine, even after fifty-five years of practice." The reader will rejoice in the distinguished fulfillment of the author's purpose.

Pathology of the Central Nervous System.

By Cyril B. Courville, M.D., Professor of Neurology and Psychiatry, College of Medical Evangelists; Director Cajal Laboratory of Neuropathology, Los Angeles County Hospital. Cloth, 8 vo. of 344 pages with 200 cuts of photographs and pen drawings. Mountain View California: Pacific Press Publishing Association.

Otologists will find much to interest them in this book; first, because of its excellent treatment of the intracranial diseases arising from the ear, and second, because of the clear and direct manner in which the underlying pathology of these conditions is treated.

The first part of the book deals with the histopathological changes in nerve tissue, anomalies and malformations of the nervous system and diseases of the intracranial blood vessels. Particular attention is given to thrombosis of the lateral sinus and the various avenues of infection are shown.

The material is based upon statistical data obtained in a series of fifteen thousand autopsies, which lends some measure of accuracy to the studies of the incidence of central nervous disease. There is a profusion of illustrations and diagrams of unusual directness and clarity.

Short-Wave Diathermy.

By Tibor de Cholnoky, M.D., F.A.C.S., Associate in Surgery, New York Post-Graduate Medical School, Columbia University. 8 vo. of 310 pages with 38 illustrations. Cloth. New York: Columbia University Press, 1937. $4.00.

The author, in his preface, observes that "during the past eight years approximately 750 articles, books and other publications have appeared, dealing with short-wave diathermy." The present work is an attempt to analyze and evaluate the methods advocated in this literature.

Following a short treatment of the physics of short-wave diathermy and an account of experiments on bacteria and on animals, the remainder of the book deals with the application of short-wave therapy to individual diseases.

There is not much that is of direct interest to the laryngologist and what there is is fairly superficial, dealing chiefly with case reports.

The Larynx and Its Diseases.

By Chevalier Jackson, M.D., Sc.D., LL.D., F.A.C.S., Professor of Bronchoscopy and Esophagoscopy, Temple University, Philadelphia, and Chevalier L. Jackson, A.B., M.D., M.Sc. (Med.), F.A.C.S., Professor of Clinical Bronchoscopy and Esophagoscopy, Temple University, Philadelphia. 555 pages with 221 illustrations, including 11 plates in color. Philadelphia and London: W. B. Saunders Company, 1937. Cloth, $8.00 net.

This book was written to supply the need of a textbook devoted exclusively to the larynx and its diseases. The authors feel that the larynx has been somewhat neglected in this country, in the practice as well as in the literature.

Accordingly, the material is dealt with in textbook style. Beginning with a comprehensive chapter on the anatomy and physiology of the larynx, the succeeding chapters deal didactically with the various laryngeal disease entities. The four concluding chapters describe the various surgical procedures as practiced and taught at the Jackson Bronchoscopic Clinic.

The Practitioners' Library of Medicine and Surgery. Vol. XI. Eye, Ear, Nose and Throat.

Supervising Editors: George Blumer, M.A. (Yale), M.D., David P. Smith, Clinical Professor of Medicine, Yale University School of Medicine, Consulting Physician to the New Haven Hospital. Associate Editors: Arthur M. Yudkin, M.D., Clinical Professor of Ophthalmology, Yale University School of Medicine, and Paul B. MacCready, M.D., F.A.C.S., Assistant Clinical Professor of Otolaryngology, Yale University School of Medicine. Cloth. 8 vo. of 1153 pages, profusely illustrated. New York: D. Appleton-Century Company, 1937.

Of some interest to rhinologists is the volume on the eye, ear, nose and throat, Volume XI, of the Practitioners' Library of Medicine and Surgery, which has lately appeared. This is hardly to be regarded as a textbook, but rather as a series of essays by some thirty or forty authors, all actively engaged in the specialties and most of them teachers.

In a textbook, one looks for an exposition of accepted theories and procedures, all carefully described, without any special emphasis on the part of the author, beyond that dictated by current practice. In this book, on the contrary, each author advocates and supports those views and methods which have given him the best results. This has the advantage of freshness and freedom from the hidebound quality of many texts, and while there is much that may be considered debatable, and an occasional opinion which may be held as personal, or better, regional, the book is stimulating, and good reading.

It will be of better service to the man of some experience than to the beginner.

Notices

The American Board of Otolaryngology

An examination was held in Philadelphia, June 7th and 8th, prior to the meeting of the American Medical Association. Ninety-four candidates were examined—of this number seventy-two were certified.

An examination will be held in Chicago, October 8th and 9th, prior to the meeting of the American Academy of Ophthalmology and Otolaryngology.

Prospective applicants for certificates should secure application blanks from the Secretary, Dr. W. P. Wherry, 1500 Medical Arts Building, Omaha, Nebraska.

W. P. Wherry, M.D., Secretary.

H. P. Mosher, M.D., President.

Advisory Board for Medical Specialties

The annual meeting of the Advisory Board for Medical Specialties, which is the coördinating Board of the twelve certifying boards in the various specialties, the Association of Medical Colleges, the American Hospital Association, the Federation of State Medical Boards of the U. S. A., and the National Board of Medical Examiners was held at Atlantic City, N. J., on June 6, 1937.

The following officers were elected:

Officers and Executive Committees

Willard C. Rappleye, M.D., President, New York, N. Y.
W. P. Wherry, M.D., Vice-President, Omaha, Nebr.
Paul Titus, M.D., Secretary-Treasurer, Pittsburgh, Pa.
W. B. Lancaster, M.D., Boston, Mass.
R. C. Buerki, M.D., Madison, Wis.

Dr. Louis B. Wilson of Rochester, Minn., the retiring president of the Board, was elected an emeritus member of the Board.

Casselberry Prize Fund

The sum of $500.00 having accrued from the Casselberry Fund for encouraging advancement in the art and science of Laryngology and Rhinology, said sum is now available, in part or as a whole, for a prize award, decoration, or the expense for original investigation or research in the domains mentioned above. Theses or reports of work must be in the hands of the Secretary, Dr. James A. Babbitt, 1912 Spruce Street, Philadelphia, before February 1st of any given year.

Abstracts of Current Articles

NOSE

Nasal Abscess Caused by Gonococci (Absceso nasal como complicacion de la blenorragia).

Campagnari, C. (Buenos Aires). Rev. Oto-neuro-oft., Sud-Americana, 12:20 (Jan.), 1937.

The author reports an abscess of the ala nasi from which numerous intracellular gram-negative diplococci were found in thick foul pus, also containing saprophytic streptococci and staphylococci. The patient had acute gonorrhea. Washing out the abscess cavity with weak permanganate solution and use of antigonoccus serum brought down his fever and healed this rare complication in eight days.

FENTON.

Cerebrospinal Rhinorrhea.

Ballon, David H., and Ballon, H. C. (Montreal), Arch. Otolaryng., 25:57 (Jan.), 1937.

A case is reported of "spontaneous" cerebrospinal rhinorrhea in a man aged 53 whose blood gave a positive Wassermann reaction. Reference is made to the important treatise on the subject by Sir St. Clair Thomson. The frequent association of ocular symptoms already noted by Thomson, Schwab and Green is again stressed. It is hoped that late results, particularly those in a case in which an operation has been carried out, will be published.

TOBEY.

Corneal Ulcers from Maxillary Sinusitis (Ukers da córnea e sinusite maxilar).

Falcão, E. deC. (Santos), Rev. Oto.-Lar. de S. Paulo, 5:37 (Jan.-Feb.), 1937.

Rebellious and recurrent bilateral corneal ulcers during three years healed immediately upon performance of a bilateral Caldwell-Luc with removal of thickened and degenerated membranes. There has been no recurrence for eight years.

FENTON.

The Paranasal Sinuses in Diphtheria (Les sinus paranasaux dans la diphthérie).

Nathanson, A. M. (Kharkov), Rev. de O. R. L., 58:233 (Mar.), 1937.

This careful study is based on 40 autopsies, including cultures and microscopic examination of the sinus membranes secured by transorbital exenteration. Eighty-five per cent showed diphtheritic invasion, either grossly or by culture, of the ethmoids or antrums, or

both. The frontal sinuses were never involved. Infections by other organisms were frequent. Nathanson suggests the probability that the accessory sinuses may act as a reservoir for the diphtheria organism in certain carriers.

FENTON.

LARYNX

New Technique for Laryngectomy (Une nouvelle technique de laryngectomie totale).

Portmann, G. and Despons, J. (Bordeaux), Rev. de L. O. R., 58:113 (Feb.), 1937.

Because of the heavy mortality of complete laryngectomy, Portmann has, since 1934, sutured the pharyngeal walls to the skin, after the trachea has been firmly sutured below. Feeding is done through a nasal tube, and the pharyngostomy is carefully packed away from the trachea. The tracheotomy tube is worn for several weeks, until the pharyngostomy has been closed by two reversed-L skin flaps, one turned with surface inward, the other slid across so that the suture lines do not coincide. After solid union, the esophageal tube and tracheotomy tube are left out. Seven cases, all successful, are reported, as against five deaths out of sixteen reported earlier. by the usual technique. The article is accurately illustrated with stage drawings and photographs.

FENTON.

Conservative Treatment of Laryngeal Diphtheria.

Clarke, James Hay. Brit. Med. J., p. 66 (July 11), 1936.

The writer reviews his experience of the treatment of laryngeal diphtheria from August, 1930, to April, 1936, during which period eighteen cases were admitted to the hospital. In two cases tracheotomy was performed and both patients died shortly after operation. The remaining sixteen cases were all successfully treated by conservative measures and all were eventually discharged cured. Upon admission each case was immediately treated by inhalations of steam, an adequate dose of antitoxin was administered, and a mixture of tincture belladonna and tincture camphor compound, 5 minims of each to one teaspoonful of water, was administered four-hourly. In the writer's experience total occlusion of the respiratory passage did not occur, and in most instances it was possible for the patient to overcome a very considerable degree of partial obstruction. It is necessary, however, for adequate dosages of antitoxin to be given, and the patient should be placed under favorable conditions. A child suffering from laryn-

geal diphtheria is generally in a state of nervous apprehension upon admission to the hospital. During this period the patient may easily become worked up into a state of spasm of the glottis, in which tracheotomy may appear to be urgently necessary. Immediate administration of tincture of belladonna and tincture camphor compound has a definitely soothing effect and helps to prevent spasms or modifies their effects.

The prognosis of laryngeal diphtheria generally is grave, the death rate ranging from eighteen to forty per cent in different series of cases reported. Although this series of sixteen cases may not be sufficiently large in number or representative enough to enable one to express an unqualified opinion on the value of conservative measures in the treatment of laryngeal diphtheria, the writer feels that it indicates that unnecessary operative intervention can and ought to be avoided.

GOLDSMITH-MCLEOD.

Blastomycosis of the Vocal Cords Treated by Electrocoagulation Through Laryngofissure (Blastomicose das cordas vocais tratado pela electrocoagulagão atravez de uma laringofissura).

deSanson, R. C. (Rio de Janeiro), Rev. Oto.-Lar. de S. Paulo, 4:689 (Sept.-Oct.), 1936.

Having cured a buccal lesion by electrocoagulation, when similar swellings on and below the vocal cords began to interfere with breathing, laryngofissure and tracheotomy were done under local anesthesia. This case has remained well for two and one-half years; the cords are almost normal in appearance, but the voice is slightly rough.

FENTON.

PHARYNX

Tonsillectomy as a Cure for Peritonsillar Abscess (With Case Reports).

Merica, Forrest W. (Lakewood, Ohio), Arch. Otolaryng., 25:520 (May), 1937.

Twenty-one cases, the patients ranging in age from 13 to 56 years, are summarized in which tonsillectomy has been performed for quinsy, thus adding to the number already reported in the literature.

There were no complications in any case, and each patient showed immediate improvement.

His experience and recommendations coincide with those reported by other authors. A bibliography covering this subject for the past ten years is included.

TOBEY.

ESOPHAGUS, TRACHEA AND BRONCHUS

Bronchoscopotherapy in Bronchopulmonary Suppuration: Its Mechanism and Results.

Soulas, A. (Paris). J. Laryng. and Otol., 52:249 (April), 1937.

A résumé of the author's experiences with tracheobronchial drowning, bronchopneumonia, pulmonary atelectasis, broncholithiasis, pulmonary abscess and bronchiectasis.

Of the latter, the author says: "The cure of bronchiectasis treated by bronchoscopy is rare (15 per cent), and in general results only in cases of recent bronchiectasis following pulmonary abscess, bronchopneumonia or the presence of a foreign body. In all other cases we obtain only a symptomatic improvement, sometimes remarkable, with even a partial restoration to the normal state (social cures, 28 per cent).

Prolonged treatment is often necessary. In general, he repeats bronchoscopic treatment twice, seven or even eight times a year.

EAR

The Vestibular Apparatus and the Sympathetic Nervous System (L'appareil vestibulaire et le système nerveux végétatif).

Kotyza F. (Prague), Acta Oto-Lar., 25:1-51 (Jan. Feb.), 1937.

Using the oculocardiac and solar reflexes as indices of the activity of the autonomic system, before and after the Kobrak and rotatory tests, the author points out very distinct effects produced. Generally rotation increases vegetative tonus, acting more strongly on the parasympathetic than the sympathetic. The Kobrak caloric test decreases vegetative tonus, influencing the sympathetic more than the parasympathetic system. This may be due to the effect of warm water against the posterior and superior wall of the auditory meatus, exciting the vagus through its auricular branch.

FENTON.

Grafts in the Round Window in the Treatment of Certain Types of Deafness.

Hughson, Walter (Abington, Pa.), Arch. Otolaryng., 25:623 (June), 1937.

Eight operations for the grafting of fascia in the round window have been performed on persons with a loss of hearing from 40 to 50 decibels for all the critical frequencies. The cases of six of the patients are reported in detail. The remaining two, after an interval of five and three months, respectively, showed a slow but consistent improvement in the ear operated on. In an analysis of the postoperative course in these cases, the following facts are worthy of mention:

1. The graft has remained in position in every case. Direct observation through the opening in the drum during the period of healing has demonstrated this fact. It is reasonable to assume that this fixation represents an actual growth of the graft in position.

2. In no case has there been postoperative infection.

3. The drum has healed with little residual scarring in from ten days to three weeks in every instance.

4. Impairment below the original preoperative level has not occurred.

5. There has been a slight but consistent improvement in the acuity of hearing for certain frequencies in every case, the longest period of observation being ten months.

TOBEY.

The Pericarotid Venous Plexus; Its Relations to Surgical Procedures Attacking the Petrous Apex (El plexo venoso pericarotideo en relacion con intervenciones quirúrgicas que abordan la punta de la pirámide del temporal).

Podestá, R. (Buenos Aires), Rev. Oto.-Lar. de S. Paulo, 5:125 (Mar.-Apr.), 1937.

Attention is drawn to the pericarotid venous plexus described by Testut but considered unimportant by Ramadier. Podestá shows several fine sections demonstrating these veins, which may be subjected to trauma at operation, or may carry thrombosis forward to the cavernous sinus. The pericarotid sheath of connective tissue is ordinarily sufficiently heavy to protect these venules.

FENTON.

MISCELLANEOUS

Statistics on Morbidity and Mortality from Cancer in the United States.

Dublin, Louis I., Ph.D. Am. J. of Cancer, 24:4 (April), 1937.

This is an analysis of the mortality statistics as compiled by the Industrial Department of the Metropolitan Life Insurance Company. It embraces 17,500,000 policyholders living in nearly every state of the United States and in the provinces of Canada. It covers the last twenty-five years, and the experience of the insured lives closely parallels that for the general population.

In the United States cancer is responsible for 150,000 deaths a year, ranking second to heart disease as a cause of death. Detailed analysis indicated that the moderate upward trend of death rate during the last twenty-five years is spurious. The rise is practically

limited to males above 55 years. In the broad age period of 35 to 54, the trend among females was significantly downward. This difference in trend by sex may be accounted for by the fact that four-fifths of cancer among males and one-half of cancers among females occur in inaccessible sites. In general, cancers of inaccessible sites show a rise in death rate, whereas those in accessible sites show a downward trend. Improvement in diagnosis, due to increased hospitalization, improved diagnostic procedures, etc., may account for this.

Half the total number of fatal cancers are located in the digestive tract. In three years the American College of Surgeons registered almost 25,000 persons cured of cancer. Data given in the paper are based on standardized rates, and thus avoid the source of error, "aging of population," as included in crude cancer rates. There are already about 200 cancer centers throughout the country which meet the standards of equipment and personnel established by the American College of Surgeons.

JORSTAD.

Cerebral Angiography (Angiografia cerebrale).

Sai, G. (Trieste), Riv. Oto-Neuro-Oftal., Vol. 13; Jan. and Feb., Vol. 13; March and April, Vol. 13; 207-244, May and June, 1936.

This extensive article appears in three successive issues of this journal and covers about 130 pages. It contains a large number of illustrations and case reports.

The author has taken numerous angiographies on 50 patients. The technic of Maniz is employed and described in detail presenting its advantages, inconveniences and diagnostic results which he compares with data obtained in pneumographies.

The thorotrast (contrast medium) may be injected into the internal or common carotid. The advantage in using the internal carotid is that it requires less thorotrast, but it is deeply located and often difficult to reach, producing an extensive scar in a visible location. Injection of the common carotid, on the contrary, is rather easy; the residual scar is very small and slightly visible but it requires a larger quantity of thorotrast.

A considerable amount of this contrasting fluid has to be injected when additional plates are needed, and much more of it when the lateral (which is the best plate for angiographies) and the anteroposterior projections have to be taken.

Injecting the common carotid, an angiography will demonstrate, equally clearly, the circulation of the internal and external carotids.

Interpretation was difficult only in one case, due to the supraimposition of the two arterial networks.

For each injection of thorotrast two or three roentgenograms are taken at intervals of two to four seconds, thus obtaining arteriograms with the former and phlebograms with the latter.

The author explains the findings of normal angiograms and presents in detail important facts obtained in studying a series of pathologic cases.

Angiography is an excellent diagnostic method for all cases of cerebral tumors. It will render the growth visible, either by its own circulation or by displacement of adjacent blood vessels. It will show clearly and precisely tumors of large size, above all, the meningiomas in which the blood vessels are displaced considerably; however, the slowly growing infiltrating gliomas are not easily demonstrable, especially if the tumor does not reveal its own circulation. This new diagnostic method is of particular value for the demonstration of aneurisms and angiomas.

Generally it is possible to state that angiography is to be preferred to pneumography in all cases of intracranial hypertension due to tumors or abscesses, as it would avoid any marked change of the delicate equilibrium of the intracranial pressure.

Angiography may furnish other useful data in syphilitic changes of the cerebral blood vessels, also in insanity, hydrocephalus and oligophrenia. These are often demonstrated by angiography of vascular anomalies, but in these cases it is convenient to add gas encephalography, as it presents the pathologic process from a different aspect.

Pneumography gives better information than angiography in epileptics, as it distends the ventricles more with the existence of vascular anomalies.

Another completely new element, dynamic for the diagnosis of cerebral diseases, is brought out by angiography; that is, changes in the speed of the cerebral circulation following an intracranial pathologic process. For example, in a case of chronic meningitis of cystic type, the retardation in speed of the blood circulation is very evident.

The dangers and inconveniences first presented by angiography decrease and become rare as one acquires more confidence and accuracy for the purpose used.

SCIARRETTA.

The Great Vessels in Deep Infection of the Neck.

Boemer, L. C. (St. Louis), Arch. Otolaryng., 25:465 (Apr.), 1937.

A survey of 75 cases of deep infection of the neck was made.

There were two deaths in the entire series; one (unavoidable) followed neglected mastoiditis; the other death, from deep pus in the neck (unrecognized until the patient was moribund), followed tonsillitis and peritonsillar abscess.

Suppuration of the retropharyngeal glands or of the deep cervical glands accounted for the condition in the forty-nine cases in children, and all the patients recovered.

Involvement of the lower third molar tooth accounted for the condition in one-third of the cases in adults.

Involvement of the pharyngomaxillary or parapharyngeal space and the great vessels of the neck constituted the greatest hazard to life.

Fatality from unrecognized deep pus in the neck secondary to tonsillitis and peritonsillar abscess still occurs.

Early adequate drainage of the parapharyngeal space must be obtained, and this is best achieved externally.

TOBEY.

Malignant Disease of the Upper Jaw.

Öhngren, G. (Stockholm). J. Laryng. and Otol., 52:18 (Jan.), 1937.

This is a report of a series of cases from the clinic of Professor Holmgren in Stockholm. The author recommends the removal of these tumors by means of high frequency, if they are superficial. If they are deep seated they must first be exposed. The technic is carefully explained. He observes that before 1927 most of these conditions were treated by irradiation. His own removal by coagulation is supplemented by various forms of irradiation. The results are distinctly superior to those obtained before this method was used. Even so, the mortality is still more than 50 per cent within the first five years.